# Minarik DRIVES

AC & DC Motors & Drives

## YOUR SOURCE FOR AC & DC MOTOR CONTROL

*Your source for*

# AC & DC MOTOR CONTROL

For over 50 years Minarik Corporation has lead the industry with state-of-the-art manufactured solutions for DC motor control 5 Hp and below. To better service our growing customer base we have expanded our product offering by the addition of AC motors and controls, Brushless DC motors and controls, and gearheads. Minarik has a global distributor network that is supported by factory-trained engineers, sales reps and customer service personnel. Call us today at **1-800-MINARIK** or visit www.minarikdrives.com for more information on products or your nearest distributor.

## DC Drives:

- Regenerative
- SCR
- PWM
- Brushless
- Digital
- NEMA Enclosure and Chassis Models

## AC Drives:

- Programmable
- NEMA Enclosure, IP20 and Chassis Models

## Motors:

- DC Geared
- DC Non-Geared
- DC Brushless
- DC Permanent Magnet
- AC 3-phase Geared
- AC 3-phase Non-Geared

## Gearheads:

- 17, 23, 34, 42 Frame Planetary Gearheads

## *South Beloit, IL*

Minarik Drives has recently opened its brand-new 35,000 square foot manufacturing facility in South Beloit, Illinois. The building currently facilitates the engineering, sales, and production staff, employing over 65 people. The entire facility is climate and humidity controlled, and has received unconditional lab and factory approval by UL/CUL and factory approval by TUV.

Now centrally located in the United States, Minarik Drives has the ability to accommodate and service customers more efficiently and logistically. Relocating from Glendale, California, the largest UPS hub in the country is now less than 25 miles away, making standard delivery 2-3 days for 38 states.

## *Contact us:*


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## FEATURES & BENEFITS

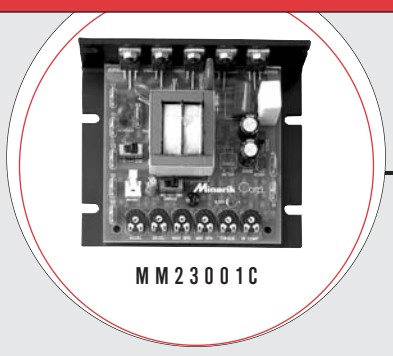
- **MM footprint:** An extremely compact size in an industry standard mounting footprint.
- **Speed range and regulation**: 1% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, current limit, acceleration and deceleration.
- **Diagnostic LED:** LED for current limit status.
- **Stopping Modes:** Coast to minimum speed with inhibit terminals (N.O.), decelerate to min speed through pot circuit External dynamic braking can be added.
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **Additional features:** Dual voltage AC input and field voltage for shunt wound motors.
- **Options and accessories:** "-Q" option includes quick disconnect terminal, power LED and a current limit header that out puts 5VDC when the drive is in current limit. DLC600 digital controller. PCM4 isolator card. 201-0024 inhibit plug with 18" leads.

### MM23000C Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| MM23011C | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 1.5 | 1.37 | 1/20-1/8 @ 90 VDC or 1/10-1/4 @180 VDC |
| MM23001C* | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 10.0* | 1.37 | 1/8-1 @ 90 VDC or 1/4-2 @180 VDC |

*The 223-0159 heatsink must be used when the MM23001C outputs above 5 amps. Drives operate from 50 - 60 Hz.

# MM23000C Series



MM23001C

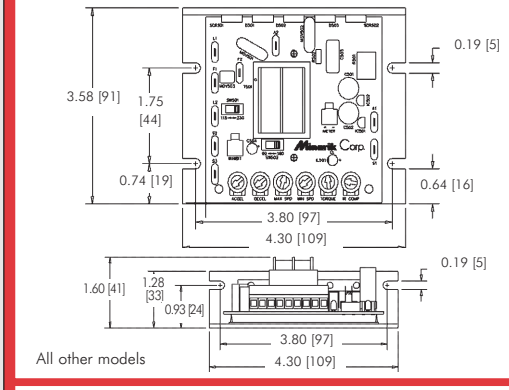
### Typical Applications

- Conveyors
- Pumps
- Packaging Equipment
- Printers
- Industrial and Commercial Machinery

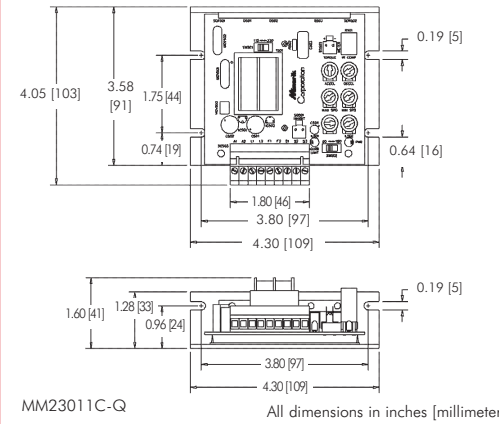
The MM23000C Series of drives are a reliable and cost-effective solution for controlling your permanent magnet or shunt-wound DC motors in variable-speed applications. Both the MM23001C and the MM23011C use SCRs to provide full-wave rectification of the AC line input. These dual voltage drives operate using 115 VAC or 230 VAC, 50/60 Hz, to operate 90 or 180 VDC SCR brush-type motors. These MM drives control motors from 1/20 to 2 Hp.

Packaged in a compact footprint, these user-friendly drives possess diagnostics and options to accommodate user needs. A current limit header, allows the drive to send a signal indicating current limit to an external control. Also, users can minimize wiring problems by specifying the *"- Q" option* to make all wire connections to the screw terminals of a quick-connect removable terminal block.

### MM23000C Dimensions




All other models




MM23011C-Q

All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 43.

## FEATURES & BENEFITS

- **Speed or torque control:** Choose operating mode using jumper pins.
- **MM footprint for chassis unit:** An extremely compact size in an industry standard mounting footprint.
- **Speed range and regulation:** 1% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, torque, accel and decel.
- **Diagnostics:** LEDs for power and current limit status.
- **Stopping modes:** Coast to minimum speed or to stop with selectable N.O. or N.C. inhibit contacts. Decelerate to minimum speed via the pot circuit. Braking on enclosed reversing models.
- **Spade and screw terminals:** Easy to use spade terminals on chassis; screw terminals on enclosed units.
- **Flexible inhibit:** Select with jumper pins the preferred inhibit functionality.
- **Additional features:** Dual voltage AC input, double sided board for less susceptibility to vibration, user-friendly terminal locations, and the ability to use a 10k or 5k ohm speed pot. Cased models come with AC line fuses and mounted operators.

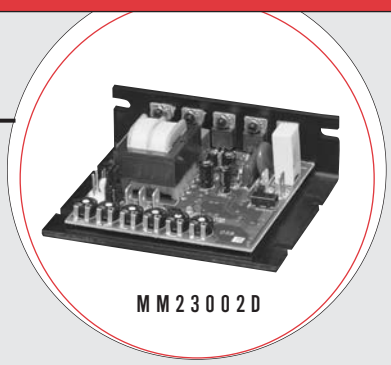
### MM23002D Series Specifications

| MM23xx2D | MM23012D | MM23112D | MM23212D[4] | MM23412D | MM23002D[1] | MM23102D[2] | MM23102D | MM23402D |
|---|---|---|---|---|---|---|---|---|
| Max. Armature Current (ADC) | 1.5 | 1.5 | 1.5 | 1.5 | 10.0[1] | 10.0[2] | 10.0 | 10.0 |
| Hp with 115VAC | 1/20 - 1/8 | 1/20 - 1/8 | 1/20 - 1/8 | 1/20 - 1/8 | 1/8 - 1 | 1/8 - 1 | 1/8 - 1 | 1/8 - 1 |
| HP with 230 VAC | 1/10 - 1/4 | 1/10 - 1/4 | 1/10 - 1/4 | 1/10 - 1/4 | 1/4 - 2 | 1/4 - 2 | 1/4 - 2 | 1/4 - 2 |
| Package Style | Chassis | NEMA 1[3] | NEMA 1[3] | NEMA 4X[3] | Chassis | NEMA 1[3] | NEMA 1[3] | NEMA 4X[3] |

1. Heatsink #223-0159 required above 5.0 ADC  2. Heatsink #223-0174 required above 5.0 ADC.  3. NEMA1 and NEMA4X dims not shown.

| | |
|---|---|
| AC Line Voltage | 115/230VAC± 10%, 50/60Hz single phase |
| Output Voltage (VDC) | 0-90 or 0-180VDC |
| Form Factor | 1.37 @ base speed |
| Accel/decel Range | 0.5 - 17 seconds |
| Reversing Models | MM23212D, MM23202D |

# MM23000D Series




### Typical Applications

- Conveyors
- Packaging Machinery
- Printing Machinery
- Sorting Machinery
- Pumps
- Material Handling Machinery

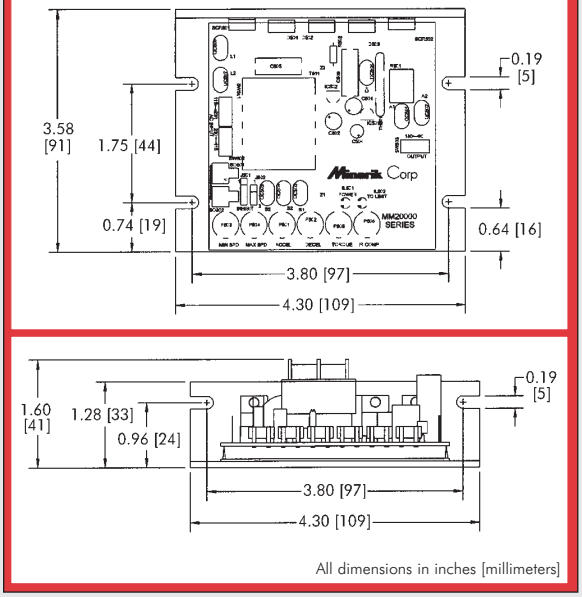
Minarik's MM23002D Series are dual voltage drives that can control speed or torque. When torque mode is selected, the functions of the speed and torque pots change. The external potentiometer sets the torque reference, the on-board Torque pot sets maximum speed and the on-board Max Speed pot sets maximum torque.

The MM23002D series has user-selectable modes for inhibit. Choose whether the inhibit terminals are to be normally open or normally closed. A jumper also selects whether inhibiting directs the motor to minimum speed or to a stop.

NEMA 1 and NEMA 4X models in the series come with wired and mounted operators and switches on the front cover and AC line fuses inside.

The MM23002D series with all its options and features provide the flexibility of control, packaging and power needed for most 1/20 to 2 Hp DC motor applications.

### MM23000D Dimensions




For matching DC motors, see pages 37 to 43.

## FEATURES & BENEFITS

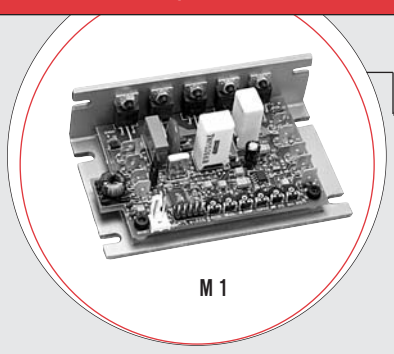
- **Compact size:** Gold extruded chassis with "MM" mounting hole locations with only a 4.30" x 2.64" footprint.
- **Speed range and regulation:** 1% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, min speed, acceleration, deceleration and torque.
- **Stopping modes:** The user can coast the motor to a stop (N.O.).
- **Spade terminals:** Easy to use, lower cost and able to fit in a smaller package.
- **Two choices for inhibit connection:** Remote start/stop control with cable and plug assembly (P/N 201-0024) or simply connect to spade terminals.
- **Programmable trimmer pot ranges:** Unique application requirements for acceleration, deceleration, current limit and IR compensation can be programmed into a chip without expensive hardware changes.
- **Additional features:** Wider than typical IR comp range for finer tuning, wide accel/decel range (.5 to 26 secs), and vibration tested to 1G.

### M1 Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|
| M1 without heatsink | 115 | 0-90 | 5 | 1.37 | 1/15 - 1/2 @ 90 VDC |
| M1 with heatsink* | 115 | 0-90 | 10* | 1.37 | 1/2 - 1 @ 90 VDC |

* M1 Series drives require an additional heat sink (p/n 223-0159) when continuous armature current is above 5 ADC.

# M1 Series



M1

### Typical Applications

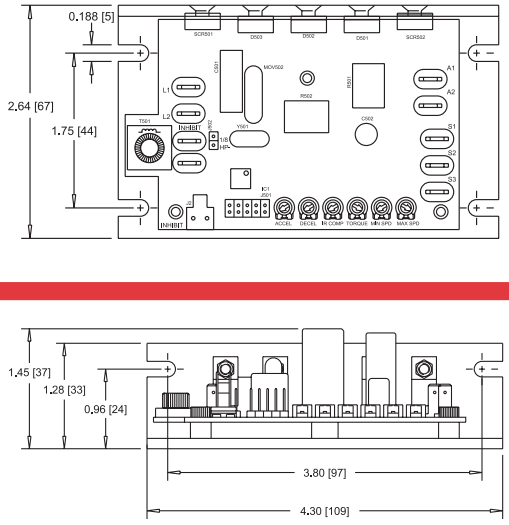
- Conveyors
- Pumps
- Packaging Equipment
- Printers
- Industrial and Commercial Machinery

Rated for 5A (1/2 hp) with 115 VAC input and 10A (1hp) with the addition of an optional heat sink, the M1 can fit where other drives with the same current ratings can't! The very compact M1 has a footprint of only 4.30" x 2.64" while conveniently maintaining the industry standard for mounting hole location.

The programmable chip on the M1 sets ranges for the acceleration, deceleration, current limit, and IR comp trimmer pots, eliminating the need of costly hardware changes for OEM applications. Other features include the inhibit function (connect via 2-pin header or via spade lugs) and a jumper to set for use with smaller motors (1/15 to 1/8 hp). The M1 also has a wider (than typical) IR comp range for finer motor tuning and a safety feature: after any motor stall, the M1 will follow the acceleration ramp setting to set speed instead of ramping up at an uncontrolled rate.

With its compact size, standard features, programmability, and 1% speed regulation, the M1 is excellent for both OEMs and users that require power and performance in an extremely small package.

### M1 Dimensions




All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 43.

## FEATURES & BENEFITS

- **Ability to control two different DC motors at once:** Jumper selectable independent or speed ratio mode.
- **MM footprint:** An extremely compact chassis in an industry standard mounting footprint.
- **Speed range and regulation:** 1% over 60:1 speed range.
- **User adjustable calibration pots:** Two each of minimum speed, maximum speed, IR compensation, current limit and acceleration/deceleration
- **Stopping modes:** Decelerate or coast (jumper selectable) using inhibit function (N.O.)
- **Spade terminals:** Allows for quick and easy terminations and changes.
- **Panel space saving:** Replace two DC drives with one compact package.
- **Speed or Torque mode:** Jumper selectable. Speed mode regulates speed and limits current. Torque mode regulates current and limits speed.
- **Microprocessor based:** Can custom program the trimmer pot ranges and inhibit for OEM applications.
- **Options & Accessories:** Heatsink 223-0159. Pot kit with connector 202-0112 (M2 ships with two pot kits included).

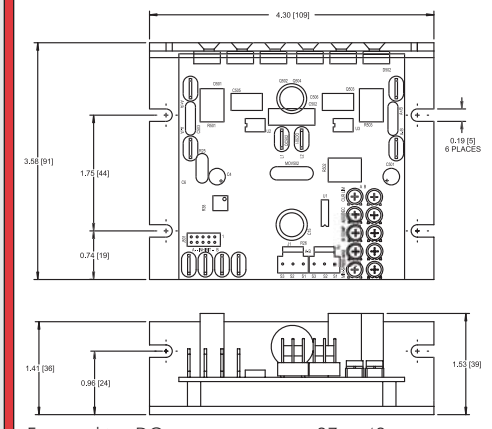
## M2 Series Specifications

| Models | Input Voltage ±10%, 1 phase, 50/60Hz (AC/DC) | Output Voltage (VDC) | Max. Cont. output for each side (Amps) | Max TOTAL output of *both* sides (Amps) | Hp Rating for each side | Max TOTAL Hp rating of *both* sides | Form Factor |
|---|---|---|---|---|---|---|---|
| M2 w/o heatsink | 115 VAC | 0-90 | 5* | 6.5* | 1/15 - 1/2 | 5/8 | 1.37 |
| M2 w/heatsink | 115 VAC | 0-90 | 10 | 11.5 | 1/15 - 1 | 1 1/8 | 1.37 |

*Heatsink 223-0159 is required whenever one side is more than 5A or the total of both sides is more than 6.5A

For matching DC motors, see pages 37 to 43.

## M2 Dimensions

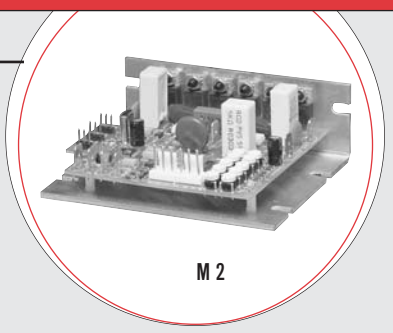



For matching DC motors, see pages 37 to 43.

# M2 Series

## Typical Applications

- Conveyors
- Material Handling Machinery
- Packaging Machinery
- Sorting Machinery
- Packaging
- Printing Machinery



M2

The M2 drive provides the power of two drives in one! Now with one DC drive, you can control two different DC motors either independently or in a ratio mode. In independent mode, each side of the M2 can be controlled differently with different trimmer pot settings and different speeds. In speed ratio mode, one speed potentiometer sets the main speed while the other one determines the ratio of the speeds between the motors. In this mode, the drive replaces two single drives and possibly a separate master/follower card resulting in extreme cost and panel space savings!

The M2 drive is easy to set up with simple jumpers to choose the modes speed/torque, independent/ratio and coast/decel to stop. In speed mode where speed is controlled, the external potentiometer sets the speed reference signal and the current limit trimmer pot sets the current limit. In torque mode, the external potentiometer sets the torque reference and the current limit trimmer pot sets the runaway speed limit.

Set up parameters are easily adjusted with on board trimmer pots. For OEMs that have fixed settings, the M2 drive is microprocessor based and can have the settings or ranges of the trimmer pots and other functions customized without any hardware changes!

The M2 drive is ideal for applications with two DC motors that are working together, two motors that run independently but are physically close, or simply when panel space is very limited.

## FEATURES & BENEFITS

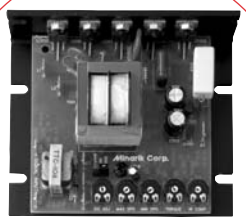
- **Isolated inputs:** Accepts floating or grounded speed reference signals of 0-10VDC or 4-20mA. 3% linearity through 50:1 speed range (60:1 for PCM23001A). 1% linearity through 30:1 speed range.
- **Speed range and regulation:** 1-2% regulation over 50:1 (60:1 for PCM23001A) speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, current limit, and signal input adjust (for external signal input only).
- **Stopping modes:** In manual mode only: decelerate to zero speed (N.O.) or add dynamic braking resistor and switch.
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **Additional features:** Manual or signal mode jumper select. 0-10V or 4-20mA signal jumper select.
- **Additional features PCM23001A only:** Third mode of signal input with ratio output, dual voltage AC input, DC field voltage.

### PCM20000A Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Output Current (ADC) | Field Supply | Hp Rating | Signal Input |
|---|---|---|---|---|---|---|
| PCM21010A | 115 | 0 - 90 | 2.0 | None | 1/20 - 1/8 @ 90 VDC | 0-10 VDC |
| PCM21000A | 115 | 0 - 90 | 10.0* | None | 1/4 - 1* @ 90 VDC | 0-10 VDC |
| PCM22000A | 230 | 0 - 180 | 10.0* | None | 1/2 - 2* @ 180 VDC | 0-10 VDC |
| PCM23001A | 115/230 | 0 - 90 or 0 - 180 | 10.0 | 50/100/200 (1 amp) | 1/8 - 1 @ 90 VDC or 1/4 - 2 @ 180 VDC | 0-10 VDC or 4-20 mA |

*Needs heatsink model #223-0159 above 5 Amps. Drives operate from 50-60 Hz

# PCM20000A Series



PCM21000A

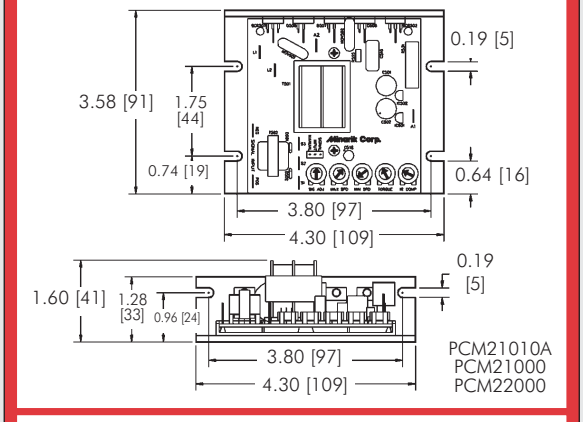
### Typical Applications

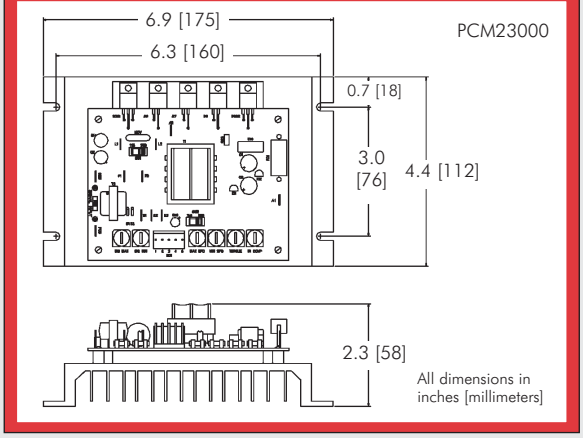
- Process Control
- Web Tensioning
- Heating Systems
- Leader/Follower and Multi-Axis Systems

The PCM20000A Series of drives are a cost-effective solution for variable speed, process control applications from 1/20 to 2 Hp. The PCM21010A, PCM21000A, PCM22000A and PCM23001A are SCR drives that integrate isolation allowing them to accept external analog process control signals. Alternative solutions require users to wire a separate isolation card to the drive which adds cost and reduces available space.

Users can operate the drives in manual mode using normal potentiometer operation or in signal mode where drive output is proportional to an external signal input. Additionally, the PCM23001A can ratio the output with a board-mounted potentiometer which proves useful in applications with multiple drives and motors. It comes with a quick connector for wiring between the three operation modes.

### PCM20000A Dimensions




For matching DC motors, see pages 37 to 43.

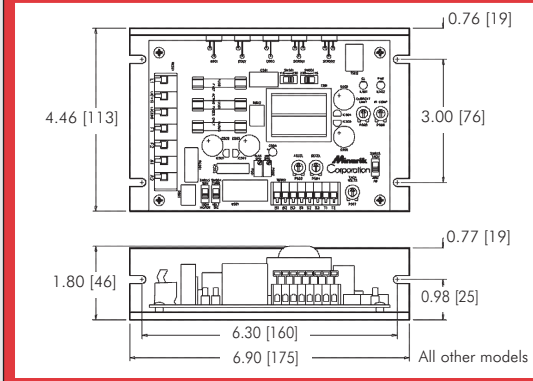
## FEATURES & BENEFITS

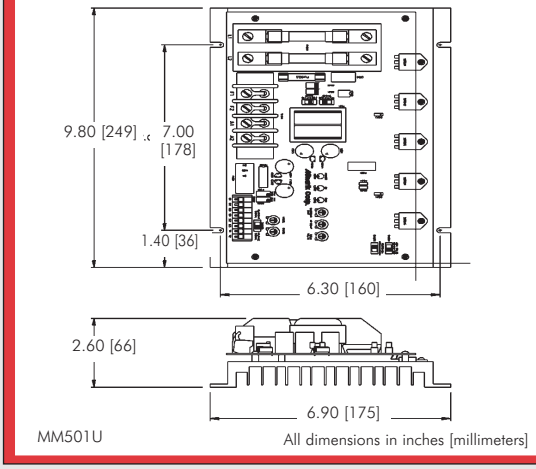
- **Isolated inputs:** Accepts floating or grounded signals of 0-10VDC or 4-20mA for controlling the speed of the motor. Burr-Brown isolation provides .01% linearity.
- **Speed range and regulation**: 1% regulation over 60:1 speed range. 0.1% regulation over 80:1 speed range with the addition of a tachometer for feedback.
- **User adjustable calibration pots:** IR compensation, min speed (12 turn), max speed (12 turn), current limit, acceleration, deceleration and tachometer.
- **Diagnostic LEDs:** LEDs for power, run (MM501U only) and current limit status.
- **Stopping modes:** Start/stop circuitry for remote pushbuttons and switches. External dynamic braking can be added. Coast to stop by removing power.
- **Cage clamp terminal block:** Quick and easy wire terminations reduce installation time!
- **Additional features:** Dual voltage AC input, tachometer feedback mode and on board fusing.

## MM Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Hp Rating | Form Factor | Max. Output Current (ADC) |
|---|---|---|---|---|---|---|
| MM311U | 115/230 | 0 - 90 or 0 - 180 | 50/100/200 (1 amp) | 1/20 - 1/8 @ 90 VDC or 1/10 - 1/4 @ 180 VDC | 1.37 | 1.5 |
| MM301U | 115/230 | 0 - 90 or 0 - 180 | 50/100/200 (1 amp) | 1/4 - 1 @ 90 VDC or 1/2 - 2 @ 180 VDC | 1.37 | 10.0 |
| MM501U | 115/230 | 0 - 90 or 0 - 180 | 50/100/200 (3 amps) | 1 - 2 1/2 @ 90 VDC or 2 - 5 @ 180 VDC | 1.37 | 25.0 |

## MM Dimensions



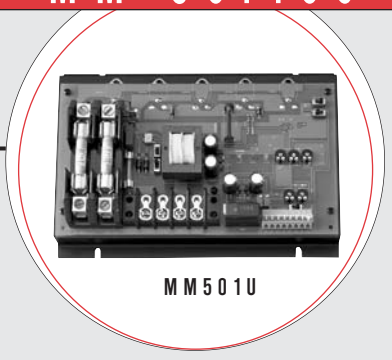




For matching DC motors, see pages 37 to 43.

# MM Series

### Typical Applications

- Leader/Follower Systems
- Conveyors
- Printers
- Office Machinery
- Web Tensioning




The MM300 and MM500 Series of dual-voltage single quadrant SCR drives control 90 or 180 VDC SCR brush-type motors ranging from 1/20 Hp through 5 Hp. The MM311U, MM301U, and the MM501U drives have integrated isolation allowing them to precisely follow analog current or voltage signals from external devices or a potentiometer as a reference for motor speed control. This results in significant labor and material cost reduction compared to other systems employing a separate drive and isolation card.

These multi-featured chassis drives accept optional inputs for start and stop. Depending on the application, users can run the drive open-loop with armature feedback, or closed-loop with tachogenerator feedback for enhanced performance. These drives accept nearly any DC tachogenerator (7-50 V/KRPM), scaleable using an adjustable tachogenerator gain potentiometer.

## FEATURES & BENEFITS

- **MM footprint:** An extremely compact size in an industry standard mounting footprint.
- **Isolated inputs:** Accepts floating or grounded signals of 0-10VDC or 4-20mA for controlling the speed of the motor. Burr-Brown isolation provides .01% linearity.
- **Speed range and regulation:** 2% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed (12 turn), max speed (12 turn), current limit, acceleration and deceleration.
- **Diagnostic LEDs:** LEDs for power, run, inhibit, and current limit status.
- **Stopping modes:** Choose N.O. or N.C. terminals to remotely decelerate to a stop by either closing or opening contacts. Decelerate to min speed via the pot circuit. Coast to stop by removing power. External dynamic braking can be added.
- **Quick disconnect terminal:** Allows users to easily wire or switch controllers.
- **Additional features:** On-board line fusing.

### MM-PCM Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Output Current (ADC) | Hp Rating |
|---|---|---|---|---|
| MM03-115AC-PCM | 115 | 90 | 3 | 1/50 - 1/8 |
| MM10-115AC-PCM | 115 | 90 | 10* | 1/8 - 1 |
| MM03-230AC-PCM | 230 | 180 | 3 | 1/25 - 1/4 |
| MM10-230AC-PCM | 230 | 180 | 10* | 1/4 - 2 |

*Use heatsink #223-0159 above 5 amps. Drives operate from 50 - 60 Hz.

# MM-PCM Series

MM03-115AC-PCM

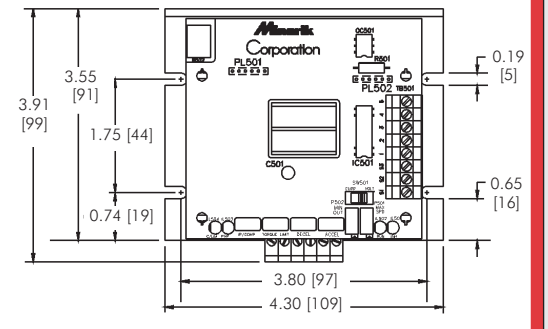
### Typical Applications

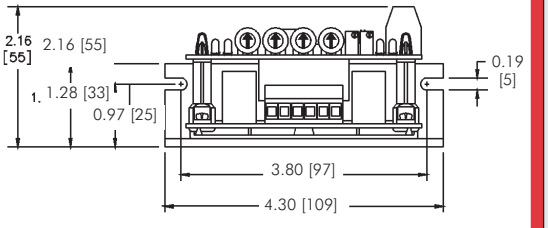
- Leader/Follower System
- Office Machinery
- Conveyors
- Packaging Machinery
- Printers
- Robotics and Specialty Machinery

Similar to our MM23001C Series in length and width, the "piggy-back" design allows for many features in a small package.

The MM-PCM Series drive accepts non-isolated voltage (0-10VDC) or current (4-20mA) signals coming from an in-plant process, programmable logic controller, motion controller, etc. to control speed. A quick connect removable terminal block allows users to quickly detach the drive without disconnecting the wires from the terminal block. Also included are optically-isolated normally-closed stop and normally-open start inputs. These allow remote starting and stopping of the motor with switches or pushbuttons.

### MM - PCM Dimensions




All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 43.

## FEATURES & BENEFITS

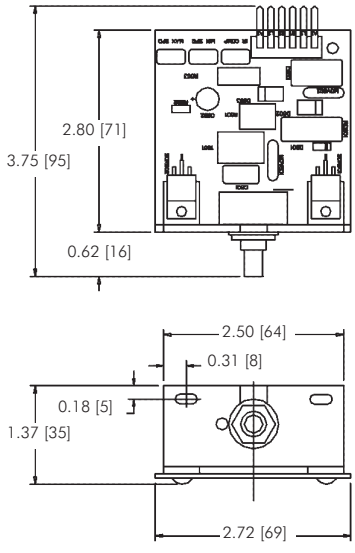
- **Low Cost:** Designed for OEMs.
- **Speed range and regulation:** 3% regulation over 20:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed and max speed.
- **Removable terminal barrier:** Greatly reduces miswiring; easy installation.
- **Optional premounted speed potentiometer:** Reduces wiring time and makes a compact package.

### MM31000 Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating | Pre-mounted Potentiometer |
|---|---|---|---|---|---|---|
| MM31701B | 115 | 0-90 | 2 | 1.37 | 1/50 - 1/8 @ 90 VDC | No |
| MM31751B | 115 | 0-90 | 2 | 1.37 | 1/50 - 1/8 @ 90 VDC | Yes |
| MM31700B | 115 | 0-90 | 3 | 1.37 | 1/8 - 1/4 @ 90 VDC | No |
| MM31750B | 115 | 0-90 | 3 | 1.37 | 1/8 - 1/4 @ 90 VDC | Yes |

# MM31000 Series

### MM Dimensions

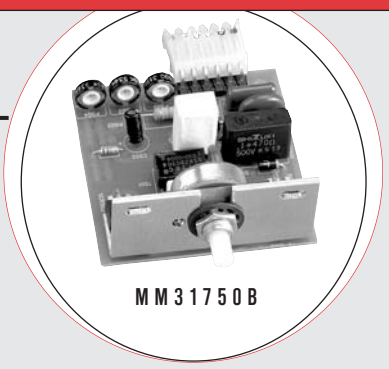



MM31751B/50B shown

All dimensions in inches [millimeters]

### Typical Applications

- Large Volume OEMs
- Feeders
- Pumps
- Conveyors
- Printers
- Industrial and Commercial Machinery



MM31750B

For cost-sensitive variable-speed applications requiring outstanding performance, Minarik offers the MM31700 Series of SCR drives. These light-weight compact drives control DC brush-type motors ranging from 1/50 to 1/4 Hp, without any additional components required. Reduced circuitry allows the cost to decrease significantly and also lends to a very compact package, ideal for original equipment manufacturers.

These MM Drives have a speed potentiometer rigidly mounted to an L-bracket on the circuit board (MM3170B/51B only). A prewired removable terminal barrier eliminates nearly half of the wiring required for other drives. Using full-wave rectification of the AC line input, these SCR drives provide moderate 20:1 speed range.

For matching DC motors, see pages 37 to 43.

## FEATURES & BENEFITS

- **NEMA 1 enclosure:** Protects against accidental contact and falling objects.
- **Speed range and regulation:** 1% regulation over 60:1 speed range. 3% for models MM21151C & MM21251C.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, current limit, acceleration & deceleration.
- **Non regen reversing:** Forward/reverse switch on cover of models MM21251C & MM23201C.
- **Diagnostic:** LED for Power On light on front of enclosure.
- **Stopping modes:** MM21251C and MM23201C have run/brake switch on front of enclosure.
- **Screw terminals:** Quick and easy wire terminations.

### MM20000 Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating | Reversing & Braking | Field Supply |
|---|---|---|---|---|---|---|---|
| MM21151C† | 115 | 0 - 130 | 2.7 | 1.10 | 1/20 - 1/4 @ 130 VDC | No | 50/100 (1 Amp) |
| MM21251C† | 115 | 0 - 130 | 2.7 | 1.10 | 1/20 - 1/4 @ 130 VDC | Yes | 50/100 (1 Amp) |
| MM23101C* | 115/230 | 0-90 or 0-180 | 10.0* | 1.37 | 1/8 - 1 @ 90 VDC or 1/4 - 2 @ 180 VDC | No | 50/100/200 (1 Amp) |
| MM23201C* | 115/230 | 0-90 or 0-180 | 10.0* | 1.37 | 1/8 - 1 @ 90 VDC or 1/4 - 2 @ 180 VDC | Yes | 50/100/200 (1 Amp) |

† A filtered drive yields higher output voltage and lower form factor.
*Needs heatsink model number 223 - 0174 above 5 amps. Drives operate from 50 - 60 Hz.

# MM20000 Series

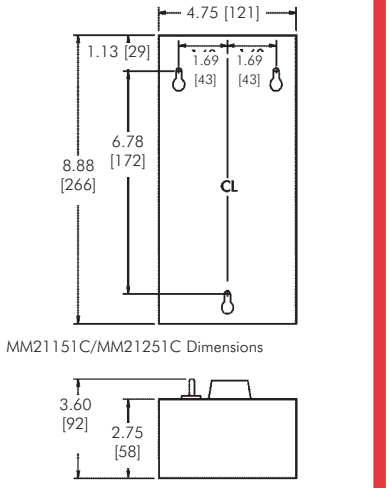
MM23201

## Typical Applications

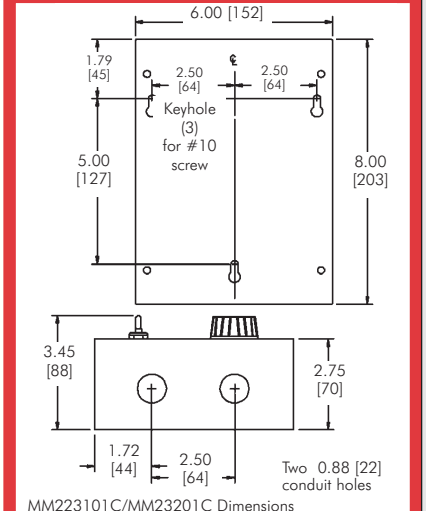
- Conveyors
- Packaging Equipment
- Printers
- Specialty Machinery
- Food Processing
- Pumps

## MM20000 Dimensions

All dimensions in inches [millimeters]



MM21151C/MM21251C Dimensions



MM223101C/MM23201C Dimensions

For matching DC motors, see pages 37 to 43.

Minarik's MM20000 Series of drives housed within an aluminum NEMA 1 enclosure guarantee protection from hands, falling dirt, or any other unwanted external solid objects that present a hazard. Additionally, the MM21251C and MM23201C have non-regenerative reversing and dynamic braking capability accessible through switches on the front of the enclosure. Users make all wire terminations at the screw terminal strip inside the enclosure, and operate the drive through the premounted speed potentiometer, power switch, and brake or reversing switch when applicable.

We offer four different MM drives that fit in NEMA 1 enclosures. Each drive is dependable and adept at controlling DC SCR brush-type motors in variable-speed applications from 1/20 to 2 Hp. Using full-wave rectification of the AC line input, these SCR drives provide a 60:1 speed range. The MM21151C and MM21251C are filtered drives that output 0-130 VDC to the motor with a 1.10 form factor. We offer single and dual voltage drives which operate from 115 VAC or 115/230 VAC, to run 90, 130 or 180 VDC motors.

## FEATURES & BENEFITS

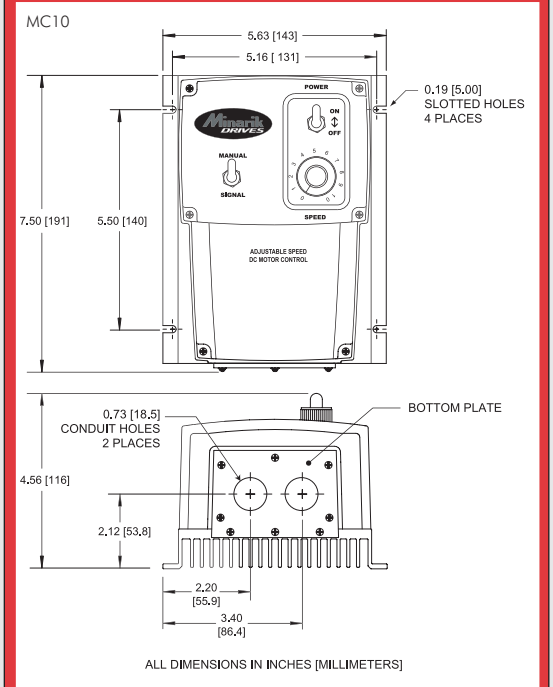
- **NEMA 4X enclosure:** Plastic enclosure protects against outer corrosive material and incidental contact.
- **Speed range and regulation**: 1% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, minimum speed, maximum speed, torque limit, acceleration, and deceleration. The MC10-PCM unit also has signal min and signal max pots.
- **Diagnostic LEDs:** LEDs for power and current limit status.
- **Mounted operators:** Speed adjust knob located on front of case for easy operation. MC10-R includes direction switch and MC10-PCM includes signal/manual switch.
- **Screw and spade terminal:** Quick and easy wire terminations.
- **Inhibit terminal:** Allows users to remotely coast the drive to minimum speed by closing the contacts.
- **Analog input reference:** MC10-PCM can accept a 0-10VDC or 1-5mA speed reference. Terminals provided for shunt resistor is a 4-20mA or other current signal is used.
- **Additional features:** Dual voltage AC input (115 or 230VAC), AC line fuses, and field voltage for shunt wound motors.

### Patriot Series Specifications

| Models | Input Voltage ±10%, 50/60Hz | Output Voltage (VDC) | Field Supply Voltage (VDC) | Max Output Current (ADC) | Hp Rating | Reversing? | Signal Isolation? |
|---|---|---|---|---|---|---|---|
| MC10 | 115/230 VAC | 0-90 or 0-180VDC (1.37 form factor) | 50/100/200 (1 amp) | 10.0 | 1/8 - 1 @ 90 VDC 1/4 - 2 @ 180 VDC | No | No |
| MC10-PCM | | | | | | No | Yes |
| MC10-R | | | | | | Yes | No |

# Patriot Series

### Patriot Dimensions




For matching DC motors, see pages 37 to 43.

### Typical Applications

- Conveyors
- Packaging Equipment
- Printers
- Specialty Machinery
- Food Processing
- Pumps

MC10-R

The Patriot Series provides a reliable and economical solution for variable speed control of permanent magnet, or shunt wound brush DC motors from 1/8 to 2 horsepower.

Housed in a NEMA 4X enclosure, the dual voltage Patriot series is ideal for washdown applications and provides protection from corrosive material, windblown dust and incidental contact.

Included is power and current limit LEDs, line fuses, inhibit pins for remote start/stop, and a speed adjust knob mounted on the front cover. In addition, the MC10 model includes an On/Off switch on the front cover; the MC10-R model- a Forward/Off/Reverse switch; and the MC10-PCM model- an On/Off switch and a Manual/Signal switch.

Setup is easy with the necessary trimmer pots and a screw terminal block for easy wire connections. The MC10-PCM model also includes shunt resistor terminals if scaling of the current signal is desired.

With excellent control and a plastic NEMA 4X enclosure, the Patriot Series is the perfect solution for many applications that require an enclosed drive.

## FEATURES & BENEFITS

- **NEMA 4X enclosure:** Protects against outer corrosive material and incidental contact.
- **Speed range and regulation:** 1% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, current limit, acceleration and deceleration.
- **Diagnostic:** LED for Power On light on front of enclosure.
- **Inhibit terminals for stopping:** Allows users to remotely coast the drive to the minimum speed by closing the contacts.
- **Screw terminals:** Quick and easy wire terminations.
- **Mounted operators:** Speed pot and power on/off switch.
- **Additional features:** Dual voltage AC input, AC line fusing, attached heatsink, and field voltage for shunt wound motors.

### MM23400C Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| MM23411C | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 1.5 | 1.37 | 1/20 - 1/8 @ 90 VDC or 1/10 - 1/4 @ 180 VDC |
| MM23401C | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 10.0 | 1.37 | 1/8 - 1 @ 90 VDC or 1/4 - 2 @180 VDC |

Drives operate from 50 - 60 Hz.

# MM23400C Series

MM23401C

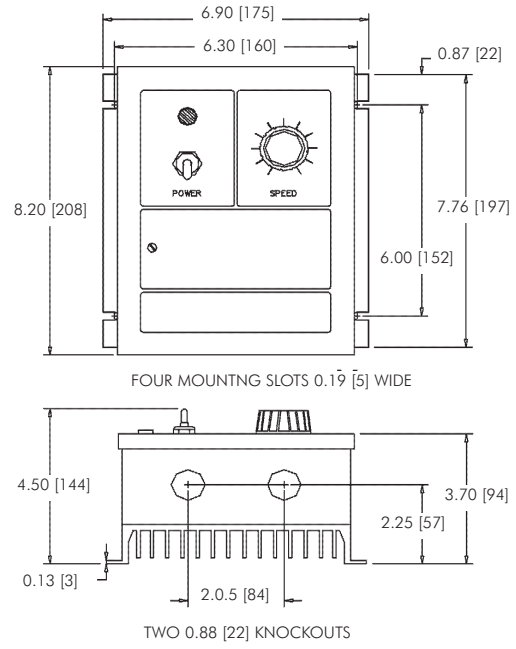
### Typical Applications

- Conveyors
- Packaging Equipment
- Printers
- Specialty Machinery
- Food Processing
- Pumps

Minarik's standard MM23400C Series of drives housed within a NEMA 4X enclosure guarantee protection from washdown applications, corrosive material, windblown dust, incidental contact with enclosed equipment, or unwanted external solid objects. The MM23401C and MM23411C provide sound performance for DC brush-type motors from 1/20 to 2 Hp. These stand-alone cased drives contain a neon power light, a pre-mounted heatsink, a power switch and speed adjustment knob accessible from the front of the enclosure.

Using full-wave rectification of the AC line input, these SCR drives provide a 60:1 speed range. Users make all wire terminations at the screw terminal block inside the enclosure. The dual voltage capability allows these drives to operate from 115 or 230 VAC, 50/60 Hz, to run 90 or 180 VDC motors.

### MM23400C Dimensions




All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 43.

## FEATURES & BENEFITS

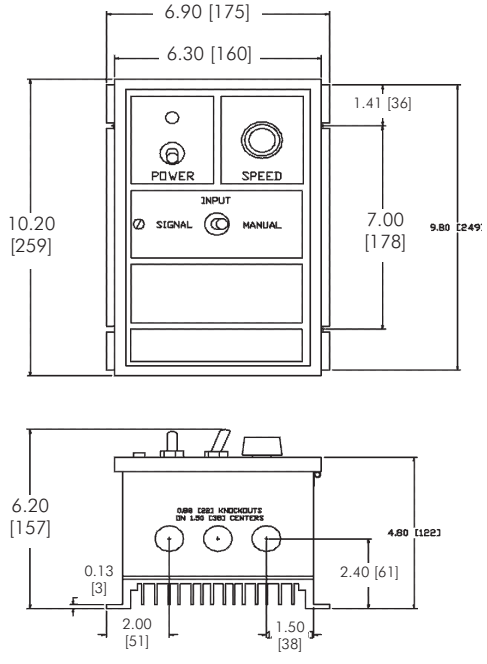
- **NEMA 4X enclosure:** Protects against outer corrosive material and incidental contact.
- **Isolated inputs:** Accepts floating or grounded signals of 0-10VDC or 4-20mA for controlling the speed of the motor. 3% linearity, through 60:1 speed range, 1% through 30:1 speed range.
- **Speed range and regulation:** 1% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, current limit, input signal min and signal max.
- **Diagnostic:** LED for Power On light on front of enclosure.
- **Spade and screw terminals:** Quick and easy wire terminations.
- **Mounted Operators:** Power on/off switch, speed potentiometer and signal/manual mode switch.
- **Additional features:** Dual voltage AC input, AC line fuses, attached heatsink and DC field voltage for shunt wound motors.

### PCM23400A Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating | Signal Input |
|---|---|---|---|---|---|---|---|
| PCM23411A | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 3.0 | 1.37 | 1/20 - 1/8 @ 90 VDC or 1/8 - 1/4 @ 180 VDC | 0-10 VDC or 4-20 mA |
| PCM23401A | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 10.0 | 1.37 | 1/8 - 1 @ 90 VDC or 1/4 - 2 @180 VDC | 0-10 VDC or 4-20 mA |

Drives operate from 50 - 60 Hz. *Some applications may require shunt resistor. Please consult manual for sizing information.

### PCM23400A Dimensions




4 MOUNTING SLOTS 0.188 IN. WIDE

All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 43.

# PCM23400A Series

### Typical Applications

- Process Control
- Leader/Follower Systems
- Food Industry
- Multi-axis Systems
- Conveyors

PCM23401A

The PCM23400A Series of full-wave rectified SCR drives are a cost-effective solution for variable speed, process control applications requiring protection from washdown, dirt, and other corrosive elements. The PCM23411A and PCM23401A accept 115 or 230 VAC for control of 90 or 180 VDC, SCR brush-type motors respectively, ranging from 1/20 to 2 Hp.

For added versatility, these drives have integrated isolation which allows them to follow analog current or voltage signals from external devices as a reference for motor speed control. Users can operate the drive in three distinct modes. 1) manual mode-normal potentiometer operation, 2) signal mode-accepts an external speed reference voltage or 3) signal with ratioing mode-accepts an external speed reference voltage that can then be scaled by an external potentiometer. The wiring configuration of a quick connector inside the case determines the operation mode. The face of a NEMA 4X enclosure has a power switch and light, manual/signal input switch, and external speed potentiometer.

## FEATURES & BENEFITS

- **MM footprint:** An extremely compact size in an industry standard mounting footprint.
- **Speed range and regulation:** 1% regulation over 100:1 speed range.
- **User adjustable calibration pots :** IR compensation, min speed, max speed, current limit, acceleration and deceleration.
- **Diagnostic LEDs:** LEDs for power and current limit status.
- **Inhibit terminals for stopping:** Allows users to remotely coast the drive to a stop (isolated on "-PCM" version).
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **16.5 kHz switching frequency:** A high switching frequency means a quiet motor!
- **Auto-ranging power supply:** Accepts AC or DC input in the 115-230V range.
- **Options and accessories:** "-PCM" option adds isolation for the speed reference input and the inhibit pins.

### MMXL Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Cont. Output (ADC) | Form Factor | Hp Rating | Isolation | Height (A) |
|---|---|---|---|---|---|---|---|
| MMXL02-D240AC | 120/240 | 0–130/0–240 | 2 | 1.05 | 1/20 - 1/4 @ 90 VDC<br>1/10 - 1/2 @ 180 VDC | Optional | 2.5 |
| MMXL05-D240AC | 120/240 | 0–130/0–240 | 5 | 1.05 | 1/4 - 1/2 @ 90 VDC<br>1/2 - 1 @ 180 VDC | Optional | 3.2 |
| MMXL10-D240AC | 120/240 | 0–130/0–240 | 10* | 1.05 | 1/2 - 1 @ 90 VDC<br>1 - 2 @ 180 VDC | Optional | 3.9 |

*Needs heatsink model number 223-0159 above 5 amps. Drives operate from 50 - 60 Hz.

# MMXL Series

MMXL05-D240AC-PCM

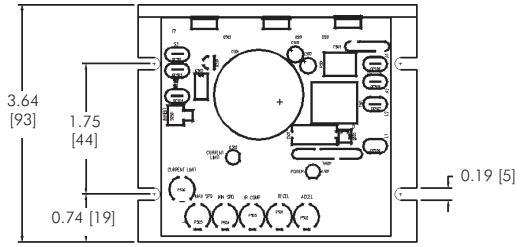
### Typical Applications

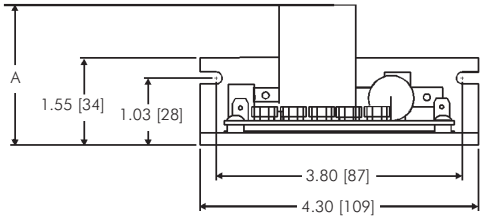
- Conveying
- Printing
- Exercise Equipment
- Film Processing
- Winding Machinery
- Packaging

Minarik has always been a leader in providing low-cost PWM motor controls. With the MMXL Series, we have done it once again! We have taken a full-featured PWM drive and reduced it down to the standard MM footprint (4.30" x 3.64").

Not only did we keep all of the features of the larger XL Series, but we even added optical isolation to the speed circuit and the inhibit circuit in the "-PCM" model. This means that the speed can be controlled with any 0-5 VDC signal and many drives can be inhibited with a single contact closure. The auto ranging power supply allows the user to apply 120 or 240 VAC without adjusting any switches. The full-featured MMXL is one of the smallest PWM drives on the market today!

### MMXL Dimensions




All dimensions in inches [millimeters]. See table above for height "A".

For matching DC motors, see pages 37 to 43.

## FEATURES & BENEFITS

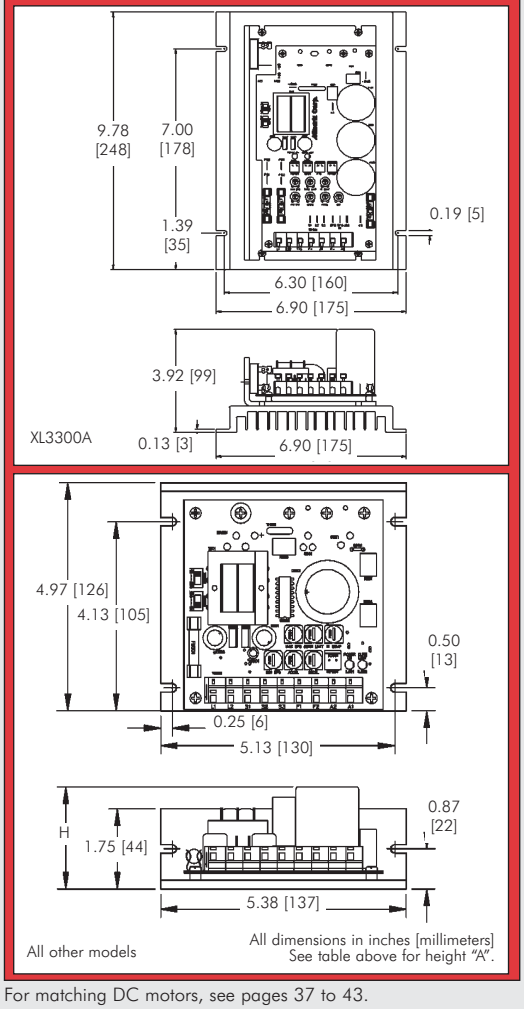
- **Speed range and regulation:** 1% regulation over 100:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, current limit, acceleration, deceleration and jog (XL3300A only).
- **Diagnostic LEDs:** LEDs for power and current limit status.
- **Inhibit terminals for stopping:** Allows users to remotely coast the drive to a stop.
- **Cage clamp terminal block:** Quick and easy wire terminations reduce installation time!
- **22 kHz switching frequency:** A high switching frequency means a quieter motor!
- **AC input/DC output switches:** Allows the selection of the lower voltage (0-130VDC) DC output for either the 115 or 230 VAC input selection.
- **Additional features:** Dual voltage AC input, DC field supply and on board line fuse.

### XL Series Specifications

| Models | Input Voltage (AC/DC) | Output Voltage (VDC) | Max. Output Current (ADC) | Field Supply (VDC) | Hp Rating | Jog Speed (% of rated) | Form Factor | Height Dimensions (H) |
|---|---|---|---|---|---|---|---|---|
| XL3025A | 120/240 | 0-130 or 0-240 | 3.0 | 50/100/200 (1 amp) | 1/20 - 1/4 @ 130 VDC or 1/8 - 1/3 @ 240 VDC | N/A | 1.05 | 2.25 [57.2] |
| XL3050A | 120/240 | 0-130 or 0-240 | 5.0 | 50/100/200 (1 amp) | 1/8 - 1/2 @ 130 VDC or 1/4 - 3/4 @ 240 VDC | N/A | 1.05 | 3.00 [76.2] |
| XL3200A | 120/240 | 0-130 or 0-240 | 10.0* | 50/100/200 (1 amp) | 1/4 - 1 @ 130 VDC or 1/2 - 2 @ 240 VDC | N/A | 1.05 | 3.75 [95.3] |
| XL3300A | 120/240 | 0-130 or 0-240 | 15.0 | 50/100/200 (1 amp) | 1/4 - 1 1/2 @ 130 VDC or 1/2 - 3 @ 240 VDC | 0 - 120% | 1.05 | 3.92 [99] |

*Needs heatsink model number 223 - 0271 above 5 amps. Drives operate from 50 - 60 Hz.

### XL Dimensions

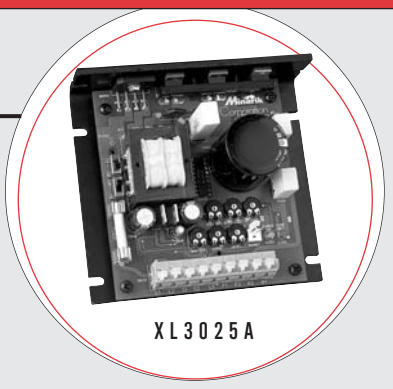



For matching DC motors, see pages 37 to 43.

# XL Series

### Typical Applications

- Medical Equipment
- Office Machinery
- Pumps
- Packaging
- Exercise Equipment
- Specialty Machinery


XL3025A

Minarik's XL Series of filtered pulse-width-modulated (PWM) variable-speed DC drives provide exceptional performance. They output nearly pure DC power to brush-type motors ranging from 1/20 to 3 Hp. Drives accept 120 or 240 VAC input to output 0 to 130 or 240 VDC, respectively; resulting in higher speeds from standard 90 or 180 VDC SCR duty motors. This innovative technology lets users operate many low voltage motors with only minor calibration adjustments.

MOSFET power devices switch at 22 kHz, which is above the audible range, to provide fast circuit response and a constant 1.05 form factor over the entire 100:1 speed range. Highly-efficient XL drives provide cool, quiet motor operation with extended brush life and low maintenance. For convenience, the drives have a cage-clamp terminal block to make wiring easy. The XL3300A can jog motors from 0 -120% of rated speed with a separate trimmer pot.

## FEATURES & BENEFITS

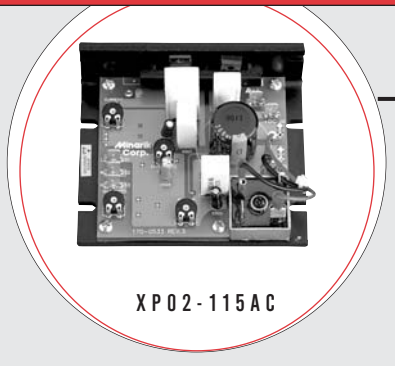
- **MM footprint:** An extremely compact size in an industry standard mounting footprint.
- **Low cost:** Designed for OEM applications.
- **Speed range and regulation:** 1% regulation over 80:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, current limit and acceleration/deceleration.
- **Stopping modes:** Decelerate to a stop (N.O.) or add dynamic braking switch and resistor.
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **22kHz switching frequency:** A high switching frequency means a quieter motor!
- **Accepts AC or DC input:** Can accept 100-160VDC input voltage or 70-130VAC.
- **Options:** "-Q" option adds a cage-clamp type terminal block and on-board fusing.

### XP Series Specifications

| Models | Input Voltage (AC or DC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating | Terminal Block | Fused | Height Dimensions (H) |
|---|---|---|---|---|---|---|---|---|
| XP02-115AC | 115 | 0 - 130 | 2.0 | 1.05 | 1/20 - 1/4 @ 130 VDC | No | No | 1.77 [45] |
| XP02-115AC-Q | 115 | 0 - 130 | 2.0 | 1.05 | 1/20 - 1/4 @ 130 VDC | Yes | Yes | 2.15 [55] |
| XP05-115AC | 115 | 0 - 130 | 5.0 | 1.05 | 1/4 - 1/2 @ 130 VDC | No | No | 2.36 [60] |
| XP10-115AC | 115 | 0 - 130 | 10.0* | 1.05 | 1/2 - 1 @ 130 VDC | No | No | 2.88 [73] |

*Needs heatsink model number 223 - 0159 above 5 amps. Drives operate from 50 - 60 Hz.

# XP Series



XP02-115AC

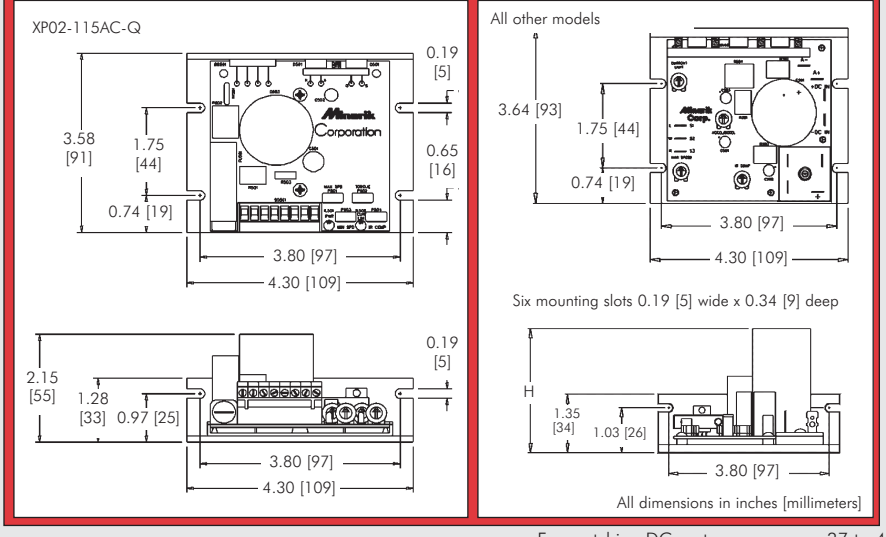
### Typical Applications

- Medical Equipment
- Office Machinery
- Food Processing
- Packaging Equipment
- Treadmills

Specifically designed for the original equipment manufacture (OEM), the XP Series of DC motor speed drives provide high performance at a low cost. These drives are well suited for XL drive candidates who do not need all of its features. The XP takes an AC line input, rectifies it and filters the output to create a DC bus that is chopped by pulse-width-modulation (PWM) circuitry to provide nearly pure DC power to the motor. The result is a form factor of 1.05 or less throughout the entire 80:1 speed range; compared to a 1.37 form factor from standard unfiltered SCR drives. The near unity form factor results in smooth, quiet, cool and low maintenance motor operation. In addition, the low form factor allows drives to operate lower voltage motors without additional circuitry.

XP drives are versatile. They can accept any AC voltage between 70 and 130 VAC. XP drives contain a unipolar power supply, which enables the drive to accept DC (100 - 160 VDC); unlike typical transformer-coupled drives. Depending on your application needs, these drives will provide speed control for motors ranging from 1/20 through 1 Hp.

### XP Dimensions




For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

- **Speed range and regulation:** 1% regulation over 30:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed and current limit.
- **Diagnostic LEDs:** LEDs for power and current limit status.
- **11 pin connector block on -SL models:** Same terminal block that was used on earlier "SL" drives. (Pin layout may vary).
- **22kHz switching frequency:** A high switching frequency means a quieter motor!
- **Additional features on -SL models:** DC field supply and on board line fuse.

### XP-SL Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Output Current (ADC) | Field Voltage (VDC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| XP01-115AC-SL | 115 | 0 - 130 | 1 | 100 | 1.05 | 1/100 - 1/25 |
| XP03-115AC-SL | 115 | 0 - 130 | 3 | 100 | 1.05 | 1/20 - 1/4 |

Drives operate from 50 - 60 Hz.

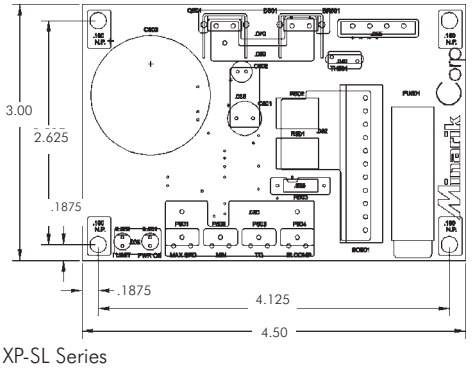
# XP-SL Series

### Typical Applications

- Medical Equipment
- Office Machinery
- Food Processing
- Packaging Equipment

XP01-115AC-SL

### XP-SL Dimensions




XP-SL Series

All dimensions in inches [millimeters]

Minarik's XP-SL series is a cost-effective, highly reliable pulse-width-modulated (PWM) drive that can be used with shunt wound, series and permanent magnet motors. It replaces Minarik's SL drive series that was an SCR drive designed for shunt wound motors.

PWM technology allows for a wider speed range and lower form factor than SCR technology. This means that the XP-SL is capable of running motors at lower speeds without an increase in motor temperature as is common with SCR drives.

For matching DC motors, see pages 37 to 48.

NEW

# 500A PWM DC



## FEATURES & BENEFITS

- **Designed for battery-powered vehicles:** Industrial or recreational.
- **PC programmable parameters:** Speed limit, current limit, throttle high and low voltages, braking amount.
- **Diagnostic:** Fault detection with flashing LED signalization.
- **Safety features:** Protection from high-speed runaway, rollaway, overheating and main contactor arcing. Under-voltage control, low power direction switching, and back-up alarm signals.
- **Outputs:** Hour meter signal for time-in-use measuring. Isolated frequency output for speedometer. "Back up" alarm signal.
- **Inputs:** Engage "hill" mode for more torque and less speed.
- **Stopping Modes:** Regenerative braking. Regen energy stored to extend battery charge range.
- **Plug in connector:** Easy wire up. Locking feature keeps connection secure.
- **Options and Accessories:** 134-0046 serial cable. Cruise control support (consult factory).

### DC500 Specifications

| Models | Input Voltage (VDC) | Output Voltage (VDC) | Max Armature Current (Amps) | Field Current Rating (A) |
|---|---|---|---|---|
| DC5004Q-36/48 | 36-48 | 36-48 | 500*/ 200† | 50*/15† |

*For 2 minutes. †for 60 minutes at 40°C

# DC500

DC5004Q-36/48

### Typical Applications

- Golf Carts
- Neighborhood Electric Vehicles
- Electric Scooters
- Electric Carts, Bikes
- Automated Vehicles
- Electric Utility Vehicles

The DC500 PWM DC drive was developed and designed for battery operated electric vehicles with separately excited DC motors.

DC500 safety features for safe integration into electric vehicles include runaway and rollaway protection, battery under-voltage control, and protection from overheating.

The DC500 drive detects when battery voltage drops too low, and will gradually boost the field current to compensate. This prevents intermittent operation of the vehicle and provides torque to get back to the charging station.

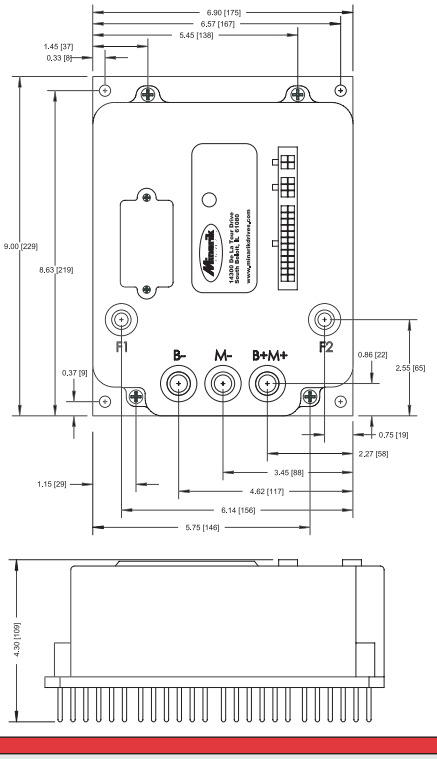
The DC500 drive heatsink has a temperature sensor that at 60°C triggers a warning signal along with gradual automatic field current boosting and armature current cutbacks to help keep the drive below the shut down temperature of 85°C. The warning signal generates progressively faster beeps as the temperature increases beyond 60°C.

Configurable safety parameters, such as speed limit, throttle voltage range, current limit and braking amount are set via any terminal program on a Windows based PC. Connection to the DC500 drive is via a standard DB9 female-male serial cable.

Additional DC500 features are an alarm signal when in reverse, regenerative braking which charges the battery, an input to select more torque and less speed, and outputs for an hour meter and a speedometer.

Packed with all the necessary features, the DC500 drive is the perfect solution for industrial or recreational battery operated vehicle motor control.

### DC500 Dimensions






Minarik DRIVES Call us toll free 1•800•MINARIK or download manuals at www.minarikdrives.com

## FEATURES & BENEFITS

- **Low voltage motor operation:** Designed for 12, 24, 36 and 48 VDC motors.
- **Speed range and regulation:** 1% regulation over 80:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, min speed, acceleration and current limit. All are independent and non-interactive.
- **Diagnostic LEDs:** Power.
- **Stopping modes:** The user can coast the motor to a stop (N.O.) using inhibit circuitry.
- **Spade terminals and screw terminal block:** Quick and easy connections.
- **DC input voltage:** Accepts DC input and outputs DC voltage up to 95% of the input with near perfect form factor.
- **One drive for two motor voltages:** On board jumper to select 12 or 24VDC motor (36 or 48VDC on some models).
- **Ideal for battery powered equipment:** Maintains variable speed control even as battery voltage declines. Extends total running time of equipment.
- **Additional features:** extruded chassis and non-interactive trimmer pots.

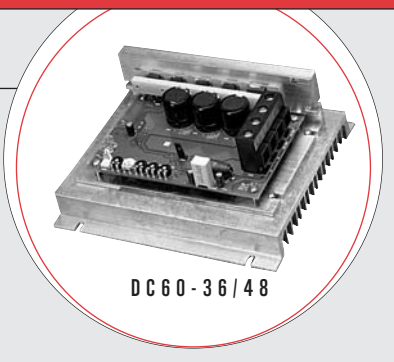
## DC to DC Series Specifications

| Models | DC Input Voltage Range | DC Output Voltage | Max Continuous Armature Current | Form Factor | Hp Rating |
|---|---|---|---|---|---|
| DC16-12/24 | 10-32 VDC | up to 95% of input | 16A | 1.01 | 1/4 - 1/2 |
| DC60-12/24 | 10-32 VDC | up to 95% of input | 60A | 1.01 | 1/2 - 1 |
| DC60-36/48 | 32-50 VDC | up to 95% of input | 60A | 1.01 | 3 |

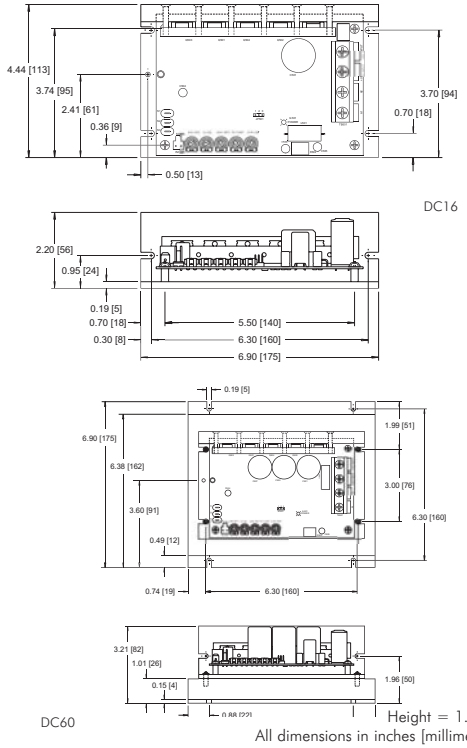
# DC-DC Series

## Typical Applications

- Electric Vehicles
- Mobility Aids
- Golf Caddies
- Battery Operated Equipment
- Pumps
- Agricultural Sprayers


DC60-36/48

## DC-DC Dimensions




The DC-DC Series are DC in/DC out PWM chassis drives. These feature rich drives include inhibit for remote starting and stopping, a power LED, and trimmer pot adjustments for minimum speed, maximum speed, acceleration, IR comp, and current limit. All trimmer pots are non-interactive making calibration quick and easy.

The DC-DC Series is available in three sizes: 16A and 60A units for 12 or 24 VDC motors and a 60A unit for 36 or 48 VDC motors. Configuring a DC Series drive for a specific motor voltage is easy with an on-board jumper. Perfect for use with battery-powered equipment, the DC-DC Series is able to maintain variable speed control as the battery discharges. This results in an increase in running time of battery-operated equipment. The DC-DC Series is also ideal for many other types of portable equipment.

The UL approved DC-DC Series comes with an extruded chassis for better heat sink transfer to the heatsink, more bus capacitance to handle ripple currents, a loose speed potentiometer and a convenient screw terminal block for wiring. With 1% speed regulation over an 80:1 speed range, the DC-DC Series is the perfect solution for low voltage, DC-to-DC applications!

# 1/50 to 2 Hp
# Low Voltage PWM DC

## FEATURES & BENEFITS

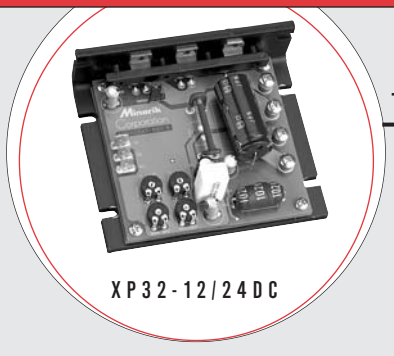
- **MM footprint:** An extremely compact size in an industry standard mounting footprint.
- **Speed range and regulation:** 1% regulation over 80:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, current limit and acceleration/deceleration.
- **Stopping modes:** Decelerate to zero speed by adding a N.O. switch to the pot circuit, or add a dynamic braking switch and resistor.
- **Low Voltage Motor Operation:** Designed for 12-60VDC motors.
- **22kHz switching frequency:** A high switching frequency means a quieter motor!
- **DC input voltage:** Accepts DC input and outputs DC voltage up to 95% of the input with near perfect form factor. Special DC input and output voltages may be accommodated. Please contact the factory.
- **Additional features:** Switch mode power supply to maintain stable drive operation under low voltage battery condition.

### XP DC Series Specifications

| Models | Input Voltage (VDC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|
| XP08-60DC | 50-70 | 0-60 | 8[1] | 1.01 | 1/50-1 |
| XP16-36/48DC | 32-50 | 0-48 | 16[1] | 1.01 | 1/50-1 |
| XP32-12/24DC | 10-32 | 0-24 | 32[2] | 1.01 | 1/50-1 |
| XP60-12/24DC | 10-32 | 0-24 | 60[2] | 1.01 | 1/10-2 |

[1] At 40°C ambient no additional heatsink is necessary. [2] XP32 and XP60 Series drives require heatsink kit 223-0159 or equivalent when continuous current is above 20 amps. Output can go as high as 95% of DC supply voltage.

# XP DC Series



XP32-12/24DC

### Typical Applications

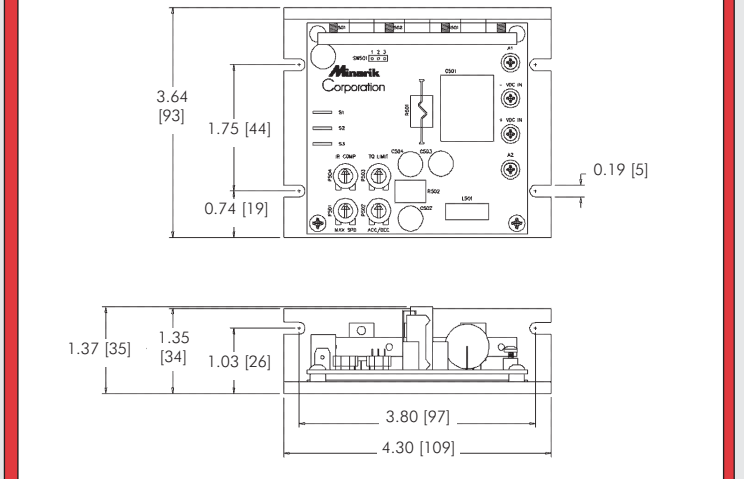
- Portable Equipment
- Electric Vehicles
- Farm Equipment
- Self-Powered Material Handling Equipment
- Fork Lifts

Minarik's XP Series of DC drives provide high performance at a low cost. Designed for applications running from a DC power supply or battery power input, the DC/DC XP Series controls brush-type DC motors from 1/50 Hp through 2 Hp. Remarkably efficient, standard DC/DC XP drives operate low voltage motors from 12 VDC to 60 VDC, up to 60 amps. Users requiring specifications outside of this range should consult the factory.

Properly rated, a single drive can operate motors from different voltage specifications. We also feature a switch mode power supply to keep the drive logic at a level sufficient for stable operation when the incoming battery voltage sags below rated specifications. Pulse-width-modulation (PWM) circuitry in the DC/DC XP drives results in quick circuit response and a constant 1.01 form factor through an 80:1 speed range.

DC/DC XP drives are ideal for applications using remote control and where AC power is inaccessible. Also, DC/DC XP drives are an excellent alternative to multiple stand-alone drives in AC powered machinery.

### XP DC Dimensions




All dimensions in inches [millimeters]

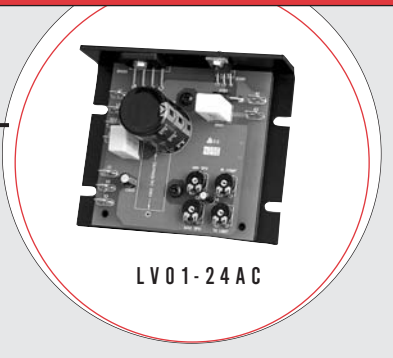
## FEATURES & BENEFITS

- **Low voltage motor operation:** Designed for 12 and 24VDC motors.
- **Speed range and regulation:** 1% speed regulation over 100:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed and torque.
- **Stopping modes:** Deceleration to zero through the pot circuit, or external dynamic braking can be added.
- **Spade terminals:** Easy to use, lower cost and able to fit in a smaller package.
- **16kHz switching frequency:** A high switching frequency means a quiet motor!
- **Additional features:** AC or DC input choices and near unity form factor throughout the speed range.

## LV Series Specifications

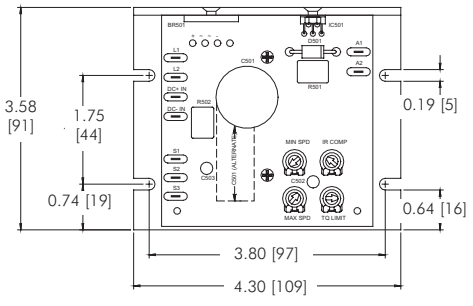
| Models | Input Voltage | Output Voltage (VDC) | Output Current (Amps) | Peak Current (Amps) | Form Factor | Form Factor |
|---|---|---|---|---|---|---|
| LV02-24AC | 8-24VAC | 0-24 VDC | 2 | 4 | 1.05 | 1/500-1/100 |
| LV02-24DC | 10-36VDC | 0-24 VDC | 2 | 4 | 1.01 | 1/250-1/50 |
| LV01-24AC | 8-24VAC | 0-24 VDC | 1 | 2 | 1.05 | 1/500-1/100 |

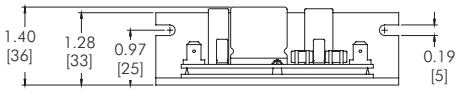
# LV Series



LV01-24AC

## LV Dimensions




All dimensions in inches [millimeters]

## Typical Applications

- Feeders
- Light Duty Conveyors
- Office Equipment
- Folders & Laminators
- Battery Powered Systems
- Mobile Systems

Minarik's LV Series of variable speed drives provide exceptional performance for your fractional horsepower, low voltage DC motor (12 and 24 VDC) by using filtered pulse-width modulation (PWM). These compact, low cost drives are designed to provide 1% speed regulation throughout a 100:1 speed range.

Packaged in a compact footprint, these user friendly drives are available with AC or DC input voltage. The auto ranging unipolar power supply allows standard LV drives to accept as inputs any AC voltage ranging from 8 to 24VAC, or DC voltage between 10 to 36 VDC. For added cost savings when the application calls for DC inputs only, the drives are available without the AC or DC power supply. The series is available with a 1 Amp output (LV01) or a 2 Amp output (LV02).

The PWM circuitry in the LV drives result in a 1.05 form factor over the entire speed range when an AC power input is provided. With a DC input these drives have an almost perfect DC form factor of 1.01. The LV Series is ideal for cost sensitive variable speed applications requiring outstanding performance, and cooler, quieter motor operation from low voltage DC motors.

## FEATURES & BENEFITS

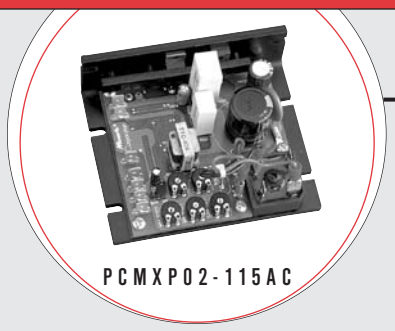
- **MM footprint:** An extremely compact size in an industry standard mounting footprint.
- **Isolated inputs:** Accepts floating or grounded speed setpoint signals of 0-10VDC. Isolation transformer provides 1% linearity.
- **Speed range and regulation:** 1% regulation over 80:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, min speed, current limit and signal adjust (external reference mode).
- **Stopping modes:** Decelerate to min speed by adding a N.O. switch or add a braking switch and resistor.
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **Two operating modes:** Speed setpoint via potentiometer or external reference signal (0-10VDC).
- **Accepts AC or DC voltage:** The XP drive accepts an AC input of 70-130VAC or a DC input of 100-160VDC.

### PCMXP Series Specifications

| Models | Input Voltage (AC) | Input Voltage (DC) | Output Voltage (VDC) | Max. Output Current (VDC) | HP Rating | Form Factor | Height (A) |
|---|---|---|---|---|---|---|---|
| PCMXP02-115AC | 70-130V | 100-160V | 0 - 130 | 2.0 | 1/20 - 1/8 @ 130 VDC | 1.05 | 1.77 [45] |
| PCMXP05-115AC | 70-130V | 100-160V | 0 - 130 | 5.0 | 1/4 - 1/2 @ 130 VDC | 1.05 | 2.36 [60] |
| PCMXP10-115AC | 70-130V | 100-160V | 0 - 130 | 10.0* | 1/2 - 1 @ 130 VDC | 1.05 | 2.88 [73] |

*Needs heatsink model number 223-0159 above 5 amps. Drives operate from 50 - 60 Hz.

# PCMXP Series



PCMXP02-115AC

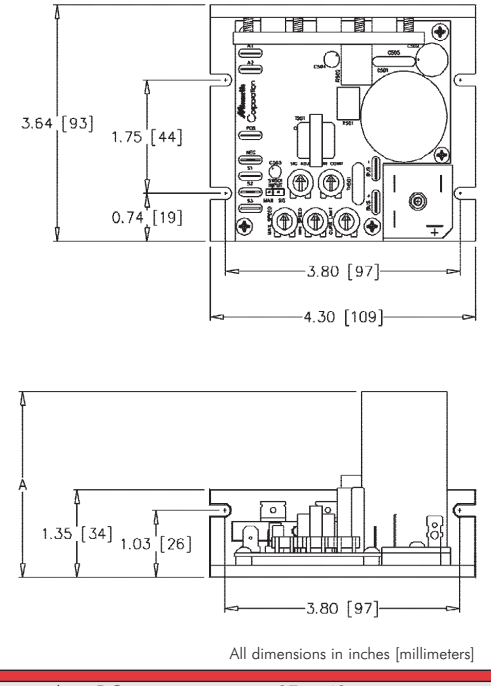
### Typical Applications

- Medical Equipment
- Office Machinery
- Web Processing
- Machine Tools
- Exercise Equipment
- Robotics

Minarik expanded the XP Series of low-cost, high-performance, pulse-width-modulation (PWM) DC drives to offer the PCMXP Series which accepts any external analog process control signal from 0 to 10 VDC. Users can operate the drives in two distinct modes: manual mode using normal potentiometer operation or signal mode: operation from an external signal input only.

Standard XP drives are versatile, and accept any voltage ranging from 70 to 130 VAC. XP drives contain a unipolar power supply, which enables them to accept any DC voltage input between 100 and 160 VDC. Users, after proper calibration, can operate many low voltage motors without additional circuitry. All Minarik PWM drives yield a constant 1.05 form factor or less over the entire 80:1 speed range resulting in smooth, quiet, cool and low maintenance motor operation.

### PCMXP Dimensions




All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

- **NEMA 1 enclosure:** Protects against accidental contact and falling objects.
- **Speed range and regulation:** 1% regulation over 80:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, current limit and min speed.
- **Stopping modes:** Decelerate to zero speed with speed pot (with built-in switch) set to "off".
- **Diagnostic LEDs:** LED for Power On light on front of enclosure.
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **22kHz switching frequency:** A high switching frequency means a quieter motor!
- **Accepts AC or DC input:** Can accept an input of 100-160VDC or 90-130VAC
- **Additional features:** AC line fuse and mounted speed pot with built-in on/off switch.

### C1XP Series Specifications

| Models | Input Voltage (AC) | Input Voltage (DC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| C1XP01-115AC-A | 90-130V | 100-160V | 0 - 130 | 1.0 | 1.05 | 1/100 - 1/10 @ 130 VDC |
| C1XP03-115AC-A | 90-130V | 100-160V | 0 - 130 | 3.0 | 1.05 | 1/10 - 1/4 @ 130 VDC |

Drives operate from 50 - 60 Hz.

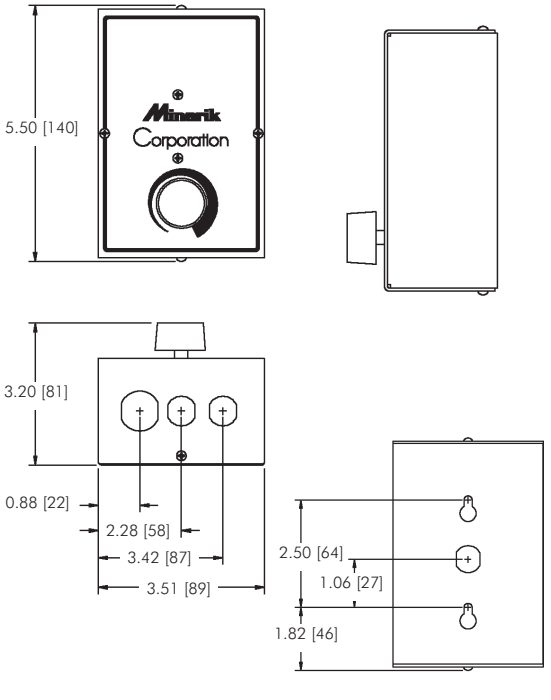
# C1XP Series

### Typical Applications

- Medical Equipment
- Office Machinery
- Food Processing
- Packaging Equipment
- Blenders and Mixers
- Woodworking Machinery

C1XP01-115AC-A

### C1XP Dimensions




All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 48.

For applications requiring basic drive protection from falling objects or incidental contact, Minarik offers the XP Series of low cost, high performance pulse-width-modulation (PWM) DC motor speed drives housed within a NEMA 1 enclosure. These filtered drives have a power-on LED and a power switch/speed adjust knob located on the front of the case. With a 115 VAC input, the XPs control 130 VDC brush-type motors from 1/100 to 1/4 Hp.

Standard XP drives accept any voltage ranging from 90 to 130 VAC. XP drives contain an inexpensive unipolar power supply, which enables them to accept any DC voltage input between 100 and 160 VDC. After proper calibration, users can also operate low voltage motors without additional circuitry. All Minarik filtered PWM drives yield a constant 1.05 form factor or less over the 80:1 speed range resulting in smooth, quiet, cool and low maintenance motor operation.

# 1/20 to 2 Hp
# PWM DC NEMA 4X

## FEATURES & BENEFITS

- **NEMA 4X enclosure:** Protects against external corrosive material and incidental contact.
- **Speed range and regulation:** 1% regulation over 100:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, current limit, acceleration and deceleration.
- **Diagnostic LEDs:** LED for Power On light on front of enclosure.
- **Stopping modes:** Coast to a stop with Power On/Off switch or via inhibit terminals (N.O.).
- **Cage clamp terminal block:** Quick and easy wire terminations reduce installation time!
- **22kHz switching frequency:** A high switching frequency means a quieter motor!
- **Additional features:** Dual voltage AC input, DC field supply, and on board line fuse.

### C4XL Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating | Jog Speed (% of Rated) |
|---|---|---|---|---|---|---|---|
| C4XL3025 | 115/230 | 0-130 or 0-240 | 50/100/200 (1 Amp) | 3.0 | 1.05 | 1/20-1/3 @ 130 VDC or 1/8-1/2 @ 240 VDC | N/A |
| C4XL3200A | 115/230 | 0-130 or 0-240 | 50/100/200 (1 Amp) | 10.0 | 1.05 | 1/4 - 1 @ 130 VDC or 1/4 - 2 @ 240 VDC | 0 - 120% |

Drives operate from 50 - 60 Hz

# C4XL Series

C4XL3200A

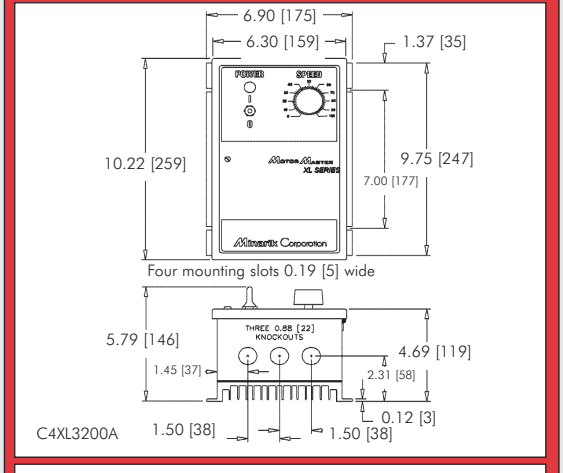
### Typical Applications

- Medical Equipment
- Centrifuges
- Food Processing
- Packaging Equipment
- Specialty Equipment

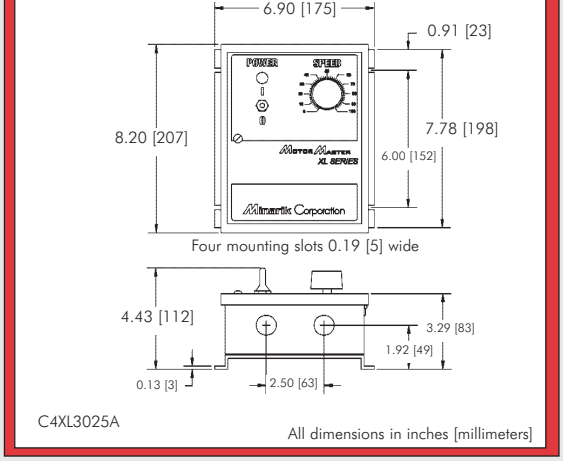
Minarik's C4XL Series of filtered pulse-width-modulated (PWM) variable speed DC drives provide exceptional performance. The C4XL Series of drives, housed within a NEMA 4X enclosure, guarantees protection from washdown, corrosive material, windblown dust, incidental contact with enclosed equipment, or unwanted external solid objects. They output nearly pure DC power to brush-type motors ranging from 1/20 to 2 Hp. The drives accept 115 or 230 VAC input to output 0 to 130 or 240 VDC, respectively; which results in higher speeds from standard 90 or 180 VDC SCR duty motors. This innovative technology lets users operate many low voltage motors with only minor calibration adjustments.

MOSFET power devices switch at 22 kHz, which is above the audible range, to provide a fast circuit response and a constant 1.05 form factor over the entire 100:1 speed range. These highly-efficient drives provide cool, quiet motor operation with extended brush life and low maintenance. In addition, they can operate smaller size, lower voltage motors to provide both cost and space savings.

### C4XL Dimensions




C4XL3200A




C4XL3025A

All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

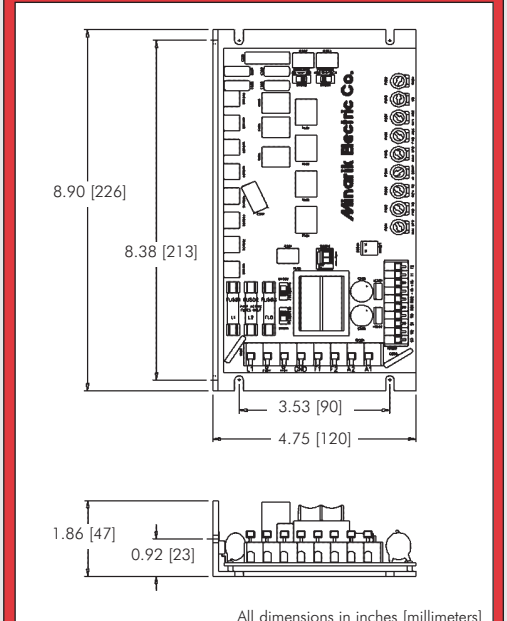
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless, reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 50:1 speed range. 0.1% regulation over 60:1 speed range with the addition of a tachometer for feedback.
- **User adjustable calibration pots:** IR compensation, forward torque, reverse torque, tachometer, min speed, max speed, forward acceleration, reverse acceleration and deadband.
- **Stopping modes:** User can decelerate (N.O.), regeneratively brake (N.O.) or coast the motor to a stop (N.O.). User can also decelerate to min speed (N.O.).
- **Cage clamp terminal block:** Quick and easy wire terminations.
- **On board fusing:** No need to add external fusing for protection of your motor or drive.
- **Additional features:** Dual voltage AC input, switch selectable armature or tachometer feedback mode and field supply for shunt wound motors.
- **Options and Accessories:** "-PCM" option adds Burr Brown isolation, 201-0024 inhibit plug for regenerative brake option, and 200-0386 limit switch logic board.

### RG500UA Series Specifications

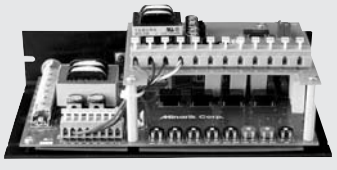
| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| RG510UA | 115/230 | 0 - 90 or 0 - 180 | 50/100/200 (1 Amp) | 3.0 | 1.37 | 1/20 - 1/8 @ 90 VDC or 1/8 - 1/4 @ 180 VDC |
| RG500UA | 115/230 | 0 - 90 or 0 - 180 | 50/100/200 (1 Amp) | 10.0* | 1.37 | 1/4 - 1 @ 90 VDC or 1/2 - 2 @180 VDC |

*Needs heatsink model number 223 - 0235 above 7 amps. Drives operate from 50 - 60 Hz.

### RG500UA Dimensions

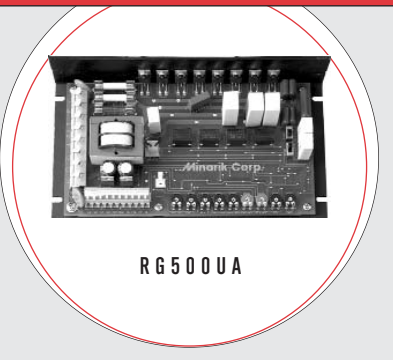



For matching DC motors, see pages 37 to 48.



RG with PCM Isolation Option, see page 90.

# RG500UA Series




RG500UA

### Typical Applications

- Conveyors
- Positioners
- Stretch Wrap
- Machinery
- Web Tensioning
- Winders
- Cranes and Hoists

Minarik's RG500 Series consists of full-wave, four-quadrant regenerative SCR drives to provide smooth motoring and braking torque for brush-type DC motors. Use the RG510UA to control motors from 1/20 through 1/4 Hp, or the RG500UA from 1/4 through 2 Hp, for single or bi-directional variable speed, without using mechanical contactors.

Slide switches allow the RG500UA and RG510UA drives to accept a 115 or 230 VAC input to run 90 or 180 VDC motors. The tach feedback mode virtually guarantees constant set speed under varying load. Applications with overhauling loads, rapid deceleration, basic positioning, and high duty cycle reversing and braking benefit from these versatile regenerative drives.

# 2 to 5 Hp
# Isolated SCR DC Regen

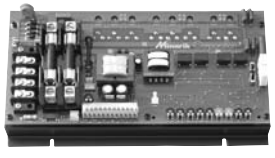
## FEATURES & BENEFITS

- **Isolated inputs:** Accepts floating or grounded signals of -250 to +250 VDC, -25 to +25 VDC, 1-5mA, 4-20mA or 10-50mA. Burr-Brown isolation has .01% linearity.
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 50:1 speed range. 0.1% regulation over 60:1 speed range with the addition of a tachometer. Armature or tachometer mode is switch selectable.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, forward acceleration, reverse acceleration, forward torque, reverse torque, deadband, input adjust (for speed reference input) and tachometer.
- **Stopping Modes:** Coast to a stop (N.O.) or regenerative brake N.O. (use 201-0024 plug with 18" leads), decelerate to zero speed (N.O.).
- **Cage clamp terminal block:** Quick and easy wire terminations reduce installation time!
- **Additional features:** Dual voltage AC input and on-board fusing.

### RG5500U Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating | Field Supply (VDC) |
|---|---|---|---|---|---|---|
| RG5500U | 115/230 | 0-90 or 0-180 | 25 cont. | 1.37 | 2-2.5 @ 90 VDC or 3 - 5 @ 180 VDC | 50/100/200 (3 Amp) |

# RG5500U

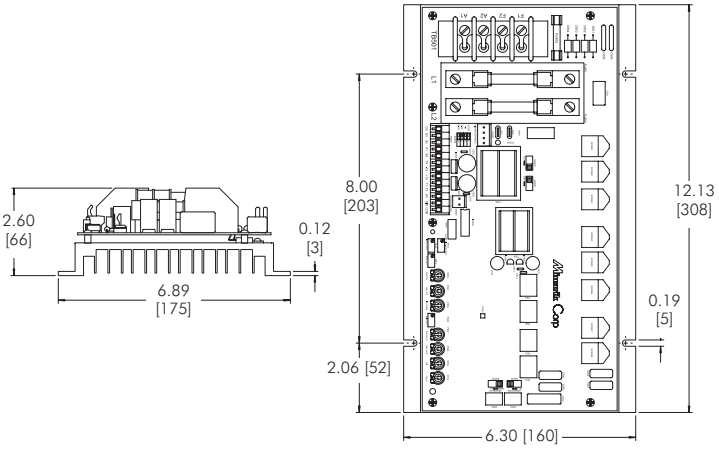


RG5500U

### Typical Applications

- Conveyors
- Printing Presses
- Textile Machinery
- Packaging Machinery
- Take-up Rolls
- Cranes and Hoists

### RG5500U Dimensions




Minarik's RG5500U drive is a of full-wave, four quadrant regenerative drive which provides smooth motoring and braking torque for SCR brush-type DC motors. The RG5500U controls motors from 2 through 5 Hp for single or bi-directional variable speed.

Applications with overhauling loads, rapid deceleration, basic positioning, and high duty cycle reversing and braking benefit from these versatile regenerative drives.

Slide switches allow the RG5500U to accept 115 or 230 VAC input to run 90 or 180 VDC motors. If you require better than 1% (armature mode) or .1% (tachometer mode) speed regulation, then you can use the DLC600 digital controller to get .01% speed regulation of set speed!

The RG5500U is excellent for leader/follower applications as well. It accepts almost any external signal input (see above).

The RG5500U drive is your answer for a full-featured regenerative drive requirement!

## FEATURES & BENEFITS

- **MM footprint:** Extremely compact size with an industry standard mounting footprint.
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless, reversing on-the-fly!
- **Speed range and regulation:** 2% regulation over 50:1 speed range. 0.5% over 60:1 speed range with the addition of a tachometer for feedback.
- **User adjustable calibration pots:** IR compensation, max speed, min speed, forward acceleration, reverse acceleration, forward torque, reverse torque, tachometer and deadband.
- **Diagnostic LEDs:** Power, forward current limit, reverse current limit.
- **Stopping modes:** The user can decelerate (N.O.), regeneratively brake (N.O.) or coast the motor to a stop (N.O. and N.C.)
- **Configurable enable and inhibit:** Can be configured to be either normally open or normally closed.
- **-PCM Option:** Isolation daughter card. Accepts non-isolated speed reference voltages between -10V and +10V.
- **-T Option:** Speed/torque adder card. Torque or speed control for both forward and reverse directions.
- **Additional features:** Tachometer feedback, gold extruded chassis and plastic capped trimmer pots.

### RG60U Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|
| RG60U without heatsink | 115/230 | 0-90/0-180 | 5 | 1.37 | 1/8 - 1/2 @90VDC<br>1/4 - 1 @ 180VDC |
| RG60U with heatsink | | | 10* | | 1/8 - 1@90VDC<br>1/4 - 2 @ 180VDC |

*Requires heatsink 223-0159 above 5A. Drives operate from 50/60Hz.

# RG60U Series

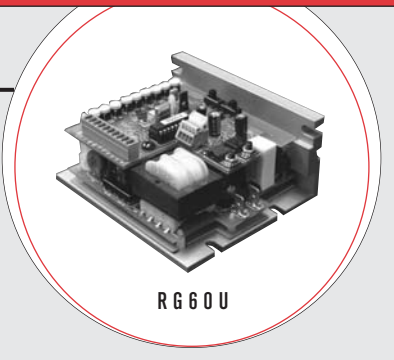
Minarik's RG60U is a compact, full-featured regen drive. Standard features include a choice of tachometer or armature feedback, nine trimmer pots including forward and reverse independent adjustments for acceleration and torque, cage clamp and plug-in terminal blocks for secure and easy connections and current limit LEDs. A unique feature on the RG60U is the ability to choose the enable and inhibit terminals to operate either 'normally open' or 'normally closed'.

The RG60U has two additional options available. The RG60U-PCM comes with isolation so that any +- 10VDC reference signal can be used. The RG60U-T comes with the ability to select torque or speed control. Torque control is useful in many web tensioning and winder applications.

Robust SCR technology with regenerative capability makes the RG60U especially ideal for high duty cycle and reversing applications.

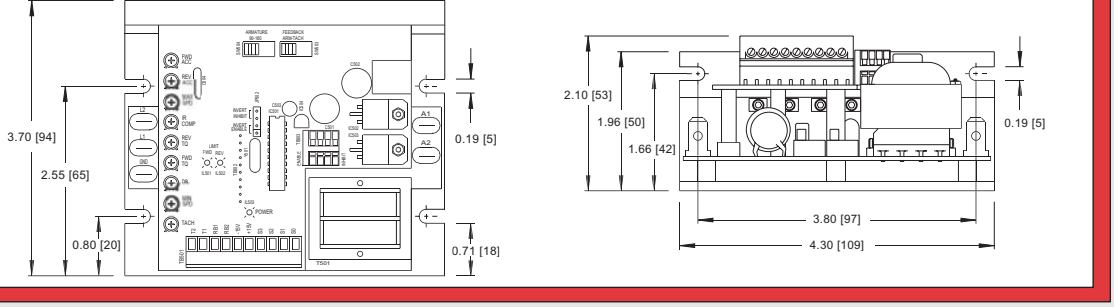
### Typical Applications

- Packaging
- Textile
- Printing
- Wrapping
- Sorting
- Sealing



RG60U

### RG60U Dimensions




For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

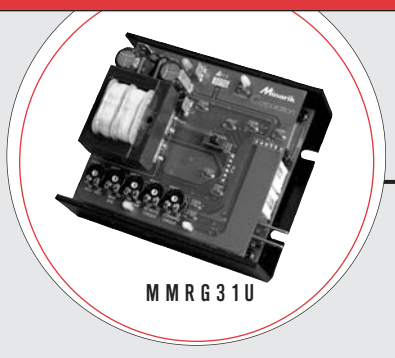
- **MM footprint:** Extremely compact size with an industry standard mounting footprint.
- **4Q reversing:** Regenerative/4 Quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 50:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, forward current limit, reverse current limit and forward acceleration (reverse deceleration), reverse acceleration (forward deceleration).
- **Stopping modes:** The user can decelerate (N.O.), regeneratively brake (N.O.), or coast motor to a stop (N.C.).
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **Options and accessories:** 201-0024 inhibit plug with 18" leads for regenerative brake option and 200-0386 limit switch logic board.
- **-PCM option:** Add a "-PCM" to the end of the part number to receive the drive with an isolation transformer daughter card. Drive will then be able to follow a -10 to +10V signal for variable speed control.

## MMRG Series Specifications

| Models | Input Voltage (AC/DC) | Output Voltage (VDC) | Output Current (amps) | Peak Current (amps) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| MMRG31U | 115 | 90 | 3 | 5 | 1.37 | 1/20 - 1/8 |
| MMRG30U | 115 | 90 | 10* | 15 | 1.37 | 1/8 - 1 |
| MMRG40U | 230 | 180 | 10* | 15 | 1.37 | 1/4 - 2 |

*Requires 223 - 0159 heat sink above 5 amps. Drives operate from 50 - 60 Hz.

# MMRG Series



MMRG31U

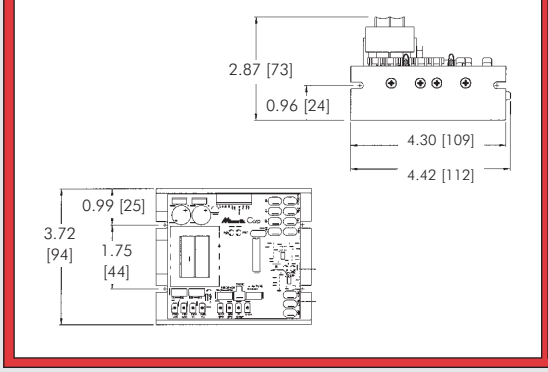
### Typical Applications

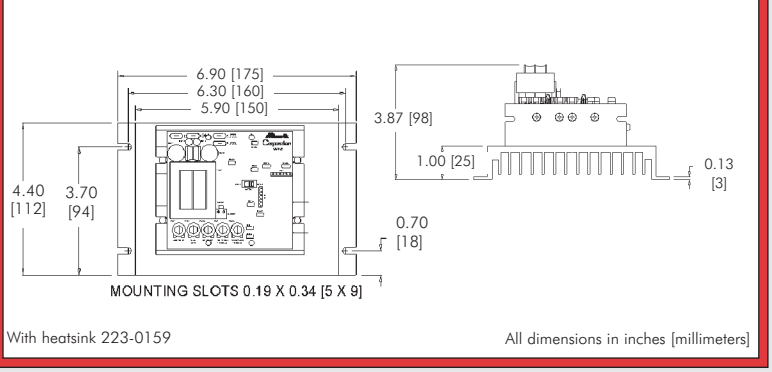
- Door Controls
- Packaging Machines
- Indexing
- Elevated Conveyors
- Web Tensioning

The MMRG Series, is one of the smallest full-wave four-quadrant drives on the market today. These full-featured, compact drives match brush-type DC motors ranging from 1/20 to 2 Hp.

The MMRG Series provides all the performance of a full size, four quadrant, regenerative variable speed drive and has our popular MM23001 footprint (3.72" x 4.42"). This drive will maintain motor speed with smooth motoring and braking torque, and allow high-duty cycle reversing and braking. It has an adjustable current limit, 1% of base speed regulation, and can regulate within a 50:1 speed range (open loop).

### MMRG Dimensions




With heatsink 223-0159

All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

- **MM footprint:** Extremely compact size with an industry standard mounting footprint.
- **4Q reversing:** Regenerative/4 Quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 50:1 speed range. 0.1% regulation over 60:1 speed range with the addition of a tachometer for feedback.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, forward and reverse current limit, forward and reverse acceleration, and tachometer.
- **Diagnostic LEDs:** LEDs for forward and reverse direction, power, forward and reverse current limit status.
- **Stopping modes:** User can regeneratively decelerate (N.O.), regeneratively brake (N.O.) or coast the motor to a stop (N.C.).
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **Additional features:** Dual voltage AC input, switch selectable armature or tachometer feedback mode and automatic deadband compensation for 50 or 60Hz power.
- **-PCM option:** Add a "-PCM" to the end of the part number to receive the drive with an isolation transformer daughter card. See Adder Boards under Drives Accessories for details.

### MMRGD Series Specifications

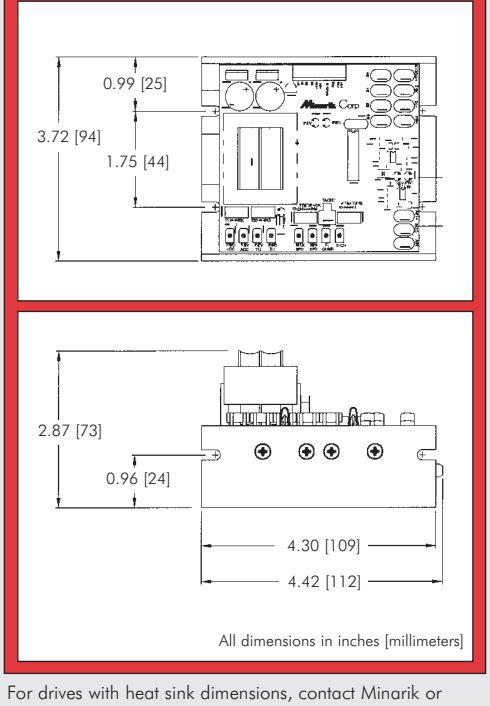
| Models | AC Line Voltage | Output Voltage (VDC) | Form Factor | Hp Rating |
|---|---|---|---|---|
| MMRGD03-D230AC | 115/230 VAC | 0-90 or 0-180 | 1.37 | 1/20 - 1/8 @ 90 VDC<br>1/10 - 1/4 @ 180 VDC |
| MMRGD10-D230AC | | | | 1/8 - 1 @ 90 VDC<br>1/2 - 2 @ 180 VDC |

*Requires 223 - 0159 heat sink above 5 amps. Drives operate from 50 - 60 Hz.

# MMRGD Series

MMRGD03-D230AC

### MMRGD Dimensions




For drives with heat sink dimensions, contact Minarik or download manuals from the web at www.minarikdrives.com. For matching DC motors, see pages 37 to 48.

### Typical Applications

- Conveyors
- Positioners
- Stretch Machinery
- Web Tensioning
- Cranes and Hoists
- Winders

Minarik's MMRGD Series is one of the smallest full-wave, full-featured regenerative digital DC drives on the market. The dual voltage (115 or 230 VAC) MMRGD not only brakes and reverses DC brush motors on the fly, but is also in the industry standard MM footprint (3.72" x 4.42").

The -PCM option can accept grounded or floating inputs. If only a unipolar signal is available, there is a terminal input for reversing direction by contact closure.

The MMRGD is compatible with our DLC600 digital controller if tighter regulation of a unidirectional set speed is required. Contact factory for connection diagram.

For applications that use limit switches, the use of the 200-0386A limit switch logic board with the MMRGD may be a good choice!

## FEATURES & BENEFITS

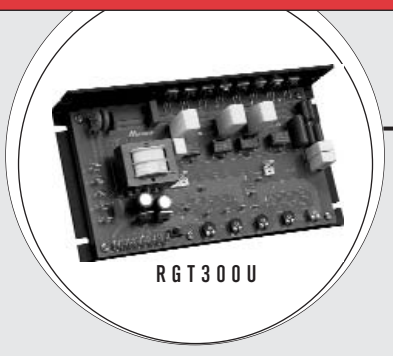
- **Low cost regenerative drive:** Designed for OEM applications.
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 60:1 speed range.
- **User adjustable calibration pots:** IR compensation, maximum speed, acceleration/deceleration, forward torque and reverse torque.
- **Stopping modes:** User can decelerate (N.O.), regeneratively brake (N.O.) or coast the motor to a stop (N.C.).
- **Spade terminals:** Easy to use, lower cost, and able to fit in a smaller package.
- **Options and accessories:** 201-0024 inhibit plug with 18" leads for regenerative brake or coast option, 200-0386 limit switch logic board and PCM4 signal isolator.
- **Optional Burr Brown isolation:** Isolation daughter card can be added by including a "-PCM" at the end of the part number. See Adder Boards under drive accessories for details.

### RGT Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Output Current (amps) | Peak Current (amps) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| RGT310U | 115 | 0 - 90 | 3 | 5 | 1.37 | 1/20 - 1/8 |
| RGT300U | 115 | 0 - 90 | 10* | 15 | 1.37 | 1/4 - 1 |
| RGT400U | 230 | 0 - 180 | 10* | 15 | 1.37 | 1/2 - 2 |

*Use heatsink 223 - 0235 when armature current is above 7ADC. Drives operate from 50 - 60 Hz.

# RGT Series

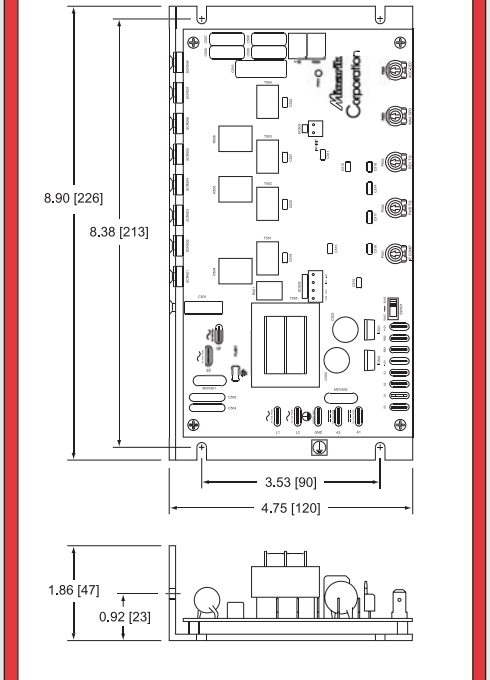


RGT300U

### Typical Applications

- Conveyors
- Packaging Machines
- Indexing
- Web Tensioning
- Door Controls

### RGT Dimensions




All dimensions in inches [millimeters]

Minarik, the leader in regenerative drive technology expands its product line with the addition of the RGT Series. These full-wave, four quadrant SCR regenerative drives contain many of the features of our popular RG Series, but are built with the high-volume cost-conscious customer in mind. The "T" stands for "trimmed" because we eliminated features that are not necessary for streamlined applications and high-volume.

RGT drives are compatible with brush-type DC motors from 1/20 to 2 Hp. If low-cost with basic features is what your application requires, the RGT is your regen.

For drives with heat sink dimensions, contact Minarik or download manuals from the web at www.minarikdrives.com. For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **MM footprint (RG25U only):** An extremely compact size in an industry standard mounting footprint.
- **Speed range and regulation:** 3% regulation over 50:1 speed range.
- **User adjustable calibration pots**: IR compensation, max speed, forward torque, reverse torque and deadband.
- **Stopping modes:** Regenerative braking (N.O.).
- **Screw terminal block (RG51UA) and spade terminals (RG25U)**: Easy to terminate wires.

### RG Series Specifications

| Models | Input Voltage (AC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|
| RG25U | 115 | 60-75 | 5 | 1.77 | 1/8 – 1/2 |
| RG51UA | 115 | 60-75 | 5 | 1.77 | 1/8 – 1/2 |

Drives operate from 50 - 60 Hz.

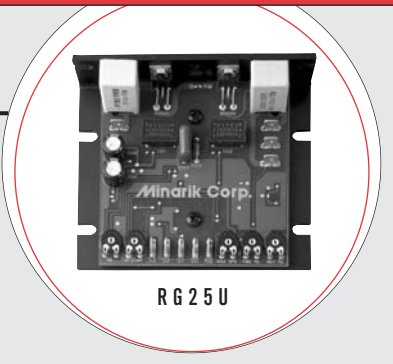
# RG Series

Regenerative drives, like Minarik's RG25U and RG51UA, control brush-type DC motors for applications that require bi-directional variable speed and smooth motoring or braking torque in either direction of rotation. The RG25U and RG51UA are ideal for OEMs: These half-wave SCR drives deliver 1/8 through 1/2 Hp. The compact size and low-cost distinguish them from other regenerative drives on the market. The RG25U drive uses the same chassis as our popular single-quadrant SCR drive, the MM23001C. It is one of the smallest 1/2 Hp Regens on the market.

Applications with overhauling loads, rapid deceleration, basic positioning, reversing and braking benefit from these versatile regenerative drives. These drives are ideal for low duty cycle applications.

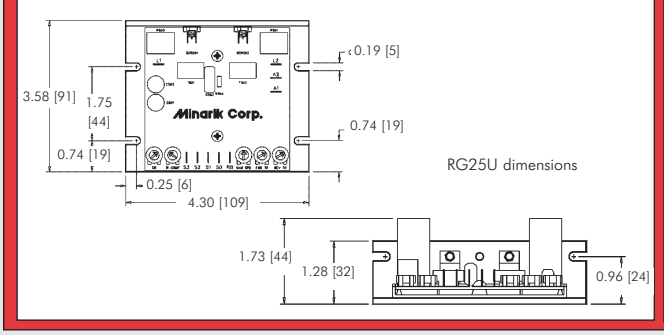
## Typical Applications

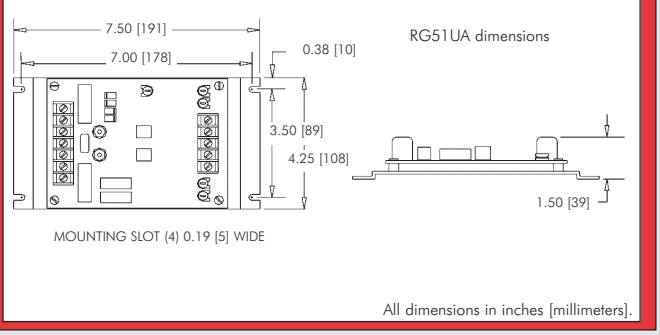
- Conveyors
- Textile Machinery
- Printing Machinery
- Packaging Machinery
- Door Openers




RG25U

## RG Dimensions




All dimensions in inches [millimeters].

For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

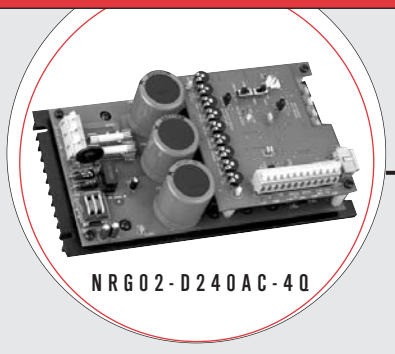
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 100:1 speed range. 0.1% regulation over 100:1 speed range with the addition of a tachometer for feedback. Armature or tachometer mode is switch selectable.
- **User adjustable calibration pots:** IR compensation, motor torque, regen torque, tachometer, min speed offset, forward max speed, reverse max speed, forward acceleration, reverse acceleration and inhibit offset.
- **Diagnostic LEDs:** LEDs for motoring, regen (torque or braking), current limit and overvoltage coast.
- **Stopping modes:** User can decelerate (N.O.), regeneratively brake (N.O.) or coast the motor to a stop (N.O.).
- **Cage clamp terminal block:** Quick and easy wire terminations.
- **Inhibit personality switch:** Choose whether you brake or coast to a stop. Use inhibit plug (201-0024).
- **Auto-ranging power supply:** Can accept a 90-240VAC or 80-340VDC as an alternative to an AC input. Connection will vary.

### NRG-4Q Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|
| NRG02-D240AC-4Q | 90-240 | 0-130/0-240 | 2 | 1.05 | 1/20 - 1/4 @ 130 VDC or 1/10 - 1/2 @ 240 VDC |
| NRG05-D240AC-4Q | 90-240 | 0-130/0-240 | 5 | 1.05 | 1/8 - 3/4 @ 130 VDC or 1/4 - 1.5 @ 240 VDC |
| NRG10-115AC-4Q | 90-120 | 0-130 | 10 | 1.05 | 1/4 - 1.5 @130 VDC |

*Some applications may require shunt resistor. Please consult factory for sizing information. Drives operate from 50 - 60 Hz.

# NRG-4Q Series



NRG02-D240AC-4Q

### Typical Applications

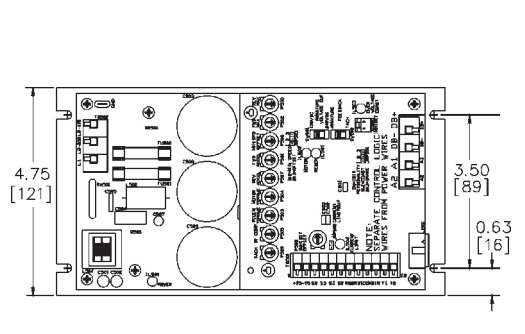
- Conveyors
- Packaging Machines
- Indexing
- Web Tensioning
- Door Controls

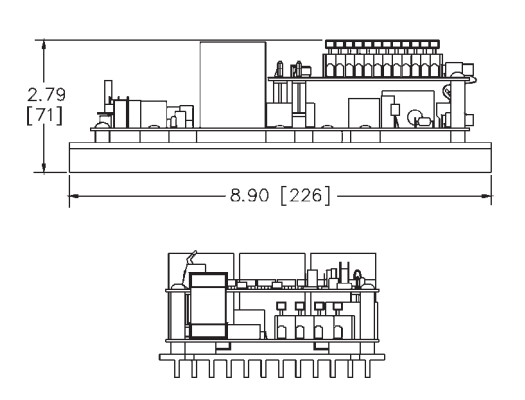
The NRG-4Q Series, with a robust set of features, is easy to use and at the same time, will satisfy demanding application requirements. In addition to on-board fusing to protect your motor and drive, the NRG will accept any AC input voltage between 90 and 240 VAC at 50 or 60Hz. With the auto-ranging power supply there are no switches to set, no settings to change.

These highly efficient, near unity form factor PWM regenerative drives will increase motor performance while reducing your energy costs. MOSFET power in PWM drives switch at 16kHz, to provide fast circuit response and the constant 1.05 (pure DC is 1.00) form factor throughout the entire 100:1 speed range.

The NRG-4Q will work with isolated logic signals, motion controllers, and programmable logic controllers. It is also compatible with Minarik's popular PCM4 signal isolator DLC600 digital controller and 200-0386A limit switch logic board. Contact factory for connections.

### NRG Dimensions




All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 48.

## FEATURES & BENEFITS

- **2Q operation**: Unidirectional operation with reverse torque capability for braking or combating over-hauling loads.
- **Speed range and regulation:** 1% regulation over 100:1 speed range.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, accel, decel, forward current limit, and brake current limit.
- **Diagnostic LEDs:** LEDs for power, motoring, and regen (torque or braking).
- **Stopping modes**: User can decelerate (N.O.), regeneratively brake (N.O.) or coast the motor to a stop (N.O.).
- **Inhibit personality switch**: Choose whether you brake or coast to a stop. Order inhibit plug with 18" leads (201-0024) to use inhibit.
- **Spade terminals**: Easy to use, lower cost, and able to fit in a smaller package.
- **Auto-ranging power supply**: Can accept 90-240VAC or an 80-340 VDC input. Connections will vary.

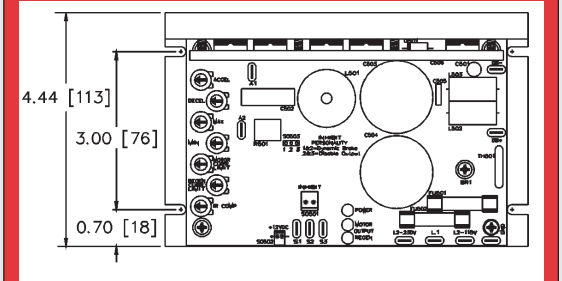
### NRG2Q Series Specifications

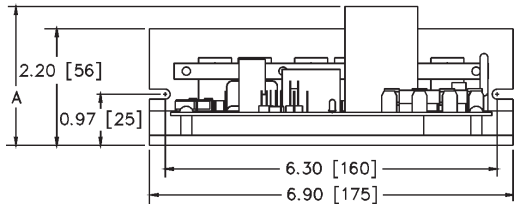
| Models | Input Voltage (AC/DC) | Output Voltage (VDC) | Max. Output Current (ADC) | Form Factor | Hp Rating | Height (A) |
|---|---|---|---|---|---|---|
| NRG02-D240AC-2Q | 90-240 | 0–130/0–240 | 2 | 1.05 | 1/20 – 1/4 or 1/10 – 1/2 | 2.62" |
| NRG05-D240AC-2Q | 90-240 | 0–130/0–240 | 5 | 1.05 | 1/8 – 3/4 or 1/4 – 1.5 | 2.62" |
| NRG10-115AC-2Q | 90-120 | 0-130 | 10 | 1.05 | 1/4 - 1.5 | 2.43" |

*Some applications may require shunt resistor. Please consult factory for sizing information. Drives operate from 50 - 60 Hz.

# NRG-2Q Series

### NRG Dimensions




All dimensions in inches [millimeters]. See table above for height "A"

All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 48.

### Typical Applications

- Elevated Conveying
- Printing
- Exercise Equipment
- Film Processing
- Winding Machinery

NRG-2Q

The NRG-2Q Series, is easy to use, and at the same time, will satisfy demanding application requirements. In addition to on-board fusing to protect your motor and drive, the NRG will accept any AC input voltage between 90 and 240 VAC at 50 or 60Hz. With an auto-ranging power supply there are no switches to set, no settings to change. The NRG-2Q will also accept any DC voltage between 80 and 340 VDC (consult factory for other input voltages).

These highly efficient, near unity form factor PWM regenerative drives will increase motor performance while reducing your energy costs. MOSFET power in PWM drives switch at 16kHz, to provide fast circuit response and the constant 1.05 (pure DC is 1.00) form factor throughout the entire 100:1 speed range.

The NRG-2Q will work with isolated logic signals, motion controllers, and programmable logic controllers. It is also compatible with Minarik's popular PCM4 signal isolator and DLC600 digital controller. Contact factory for connections.

## FEATURES & BENEFITS

- **NEMA 4X enclosure:** Rugged metal enclosure protects against dirt, water and corrosive agents.
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick contactorless reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 50:1 speed range. 0.1% regulation over 60:1 speed range with the addition of a tachometer for feedback. Armature or tachometer mode is switch selectable.
- **User adjustable calibration pots:** IR compensation, forward torque, reverse torque, tachometer, min speed, max speed, forward acceleration, reverse acceleration and deadband.
- **Diagnostic LEDs:** Power On light on front of enclosure.
- **Stopping modes:** User can regeneratively brake (run/brake), coast the motor (power on/off switch), or decelerate to a stop (N.O.). User can also decelerate to min speed (N.C.).
- **Screw terminal block:** Easy and secure wire terminations.
- **On board fusing:** No need to add external fusing for protection of your drive.

### RG500A Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| RG510A | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 3.0 | 1.37 | 1/20 - 1/8 @ 90 VDC or 1/10 - 1/4 @ 180 VDC |
| RG500A | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 10.0 | 1.37 | 1/4 - 1 @ 90 VDC or 1/2 - 2 @180 VDC |

Drives operate from 50 - 60 Hz.

# RG500A Series

RG500A

### Typical Applications

- Conveyors
- Cranes and Hoists
- Extruders
- Indexing Tables
- Packaging Machinery
- Feeders

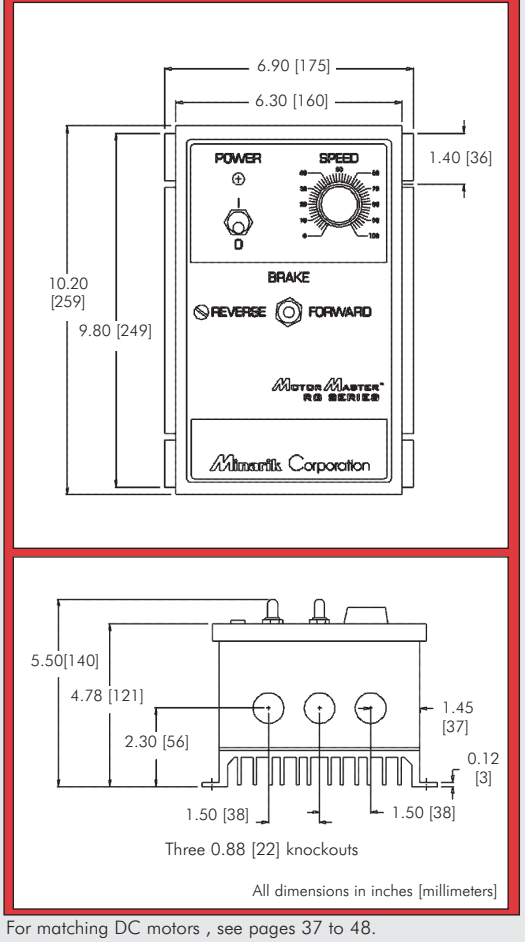
Minarik's RG500A Series consists of full-wave, four-quadrant regenerative SCR drives in a NEMA 4X enclosure to provide smooth motoring and braking torque for brush-type DC motors. Mounted operators include power on/off switch, speed potentiometer and reverse/brake/forward switch. These drives are ideal in applications requiring protection from washdown, splashing liquids, corrosive material, windblown dust, incidental contact with enclosed equipment, or any external solid objects.

Slide switches allow the RG500A and RG510A drives to accept a 115 or 230 VAC input to run 90 or 180 VDC motors. A field supply is also provided for shunt-wound motors. The switch selectable tachometer feedback mode virtually guarantees constant set speed under varying load.

The RG is compatible with the PCM4 signal isolator, the DLC digital controller and the 200-0386A limit switch logic board.

Applications with overhauling loads, rapid deceleration, basic positioning, and high duty cycle reversing and braking benefit from these versatile regenerative drives.

### RG500A Dimensions




For matching DC motors , see pages 37 to 48.

## FEATURES & BENEFITS

- **NEMA 4X enclosure:** Rugged metal enclosure protects against dirt, water and corrosive agents.
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless, reversing on-the-fly!
- **Speed range and regulation:** 1% regulation over 50:1 speed range. 0.1% regulation over 60:1 speed range with the addition of a tachometer for feedback. Armature or tachometer mode is switch selectable.
- **User adjustable calibration pots:** IR compensation, forward torque, reverse torque, tachometer, min speed, max speed, forward acceleration, reverse acceleration, deadband, forward jog, reverse jog, and dwell time (for limit switch mode).
- **Diagnostic LEDs:** LEDs for jog, forward, reverse, and stop.
- **Stopping modes:** User can regeneratively brake (stop PB), coast the motor (power off switch), or decelerate to a stop (N.O.). User can also decelerate to min speed (N.C.).
- **Cage clamp and screw terminal block:** Quick, secure and easy wire terminations.
- **On board fusing:** No need to add external fusing for protection of your drive.

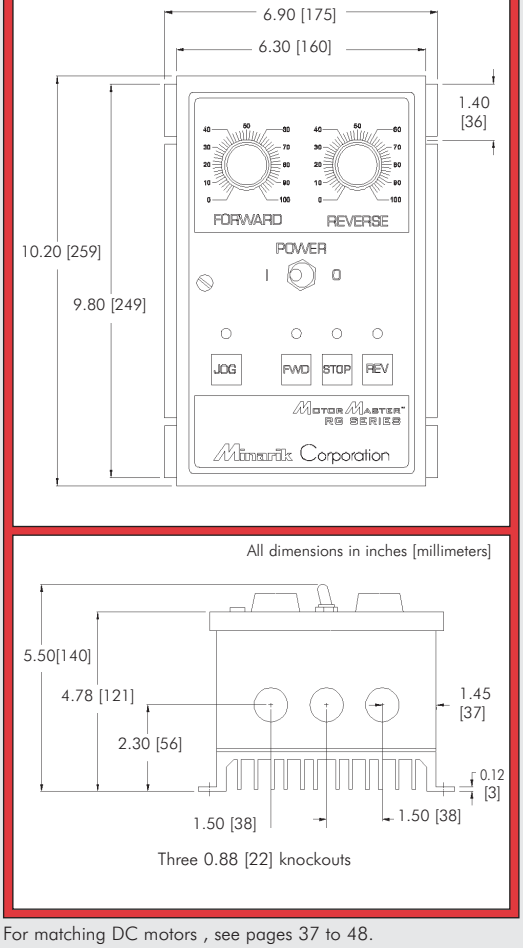
### RG500A Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VDC) | Field Supply (VDC) | Max Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|---|
| RG511A | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 3.0 | 1.37 | 1/20 - 1/8 @ 90 VDC or 1/10 - 1/4 @180 VDC |
| RG501A | 115/230 | 0-90 or 0-180 | 50/100/200 (1 Amp) | 10.0 | 1.37 | 1/4 - 1 @ 90 VDC or 1/2 - 2 @180 VDC |

Drives operate from 50 - 60 Hz.

# RG500A Series

### RG500A Dimensions




For matching DC motors , see pages 37 to 48.

### Typical Applications

- Packaging
- Conveyors
- Mixing
- Robotics
- Food Processing
- Material Handling

RG501A

The RG501A/RG511A are dual voltage full-featured regen drives with a field supply in a rugged enclosure. These high performance drives maintain motor speed with automatic motoring and braking torque, while allowing high-duty cycle reversing and braking.

The RG501A/RG511A have conveniently mounted operators. Included are a power on/off switch and separate forward and reverse speed potentiometers so independent speeds for each direction are easily set. Controlling the motor is easy too, by pressing a button on the membrane panel for stop, run, reverse, or jog (jog speed is adjustable). The user can also wire in remote pushbuttons in conjunction with the on-board buttons.

Included and wired into the RG501A/RG511A package is our limit switch logic board (200-0386A). This mini-PLC can operate in one of nine modes between limit switches including continuous cycling, single cycle, dwell and more–including adjustable stop and dwell times!

The high performance, versatile RG can be used in conjunction with our PCM4 signal isolator.

## FEATURES & BENEFITS

- **NEMA 1 enclosure:** Metal enclosure for indoor use protects against dirt, dust and bodily contact.
- **4Q reversing:** Regenerative/4 quadrant drives have the ability to perform quick, contactorless reversing-on-the-fly!
- **Speed range and regulation:** 1% regulation over 50:1 speed range. 0.1% regulation over 60:1 speed range with the addition of a tachometer for feedback. Armature or tachometer feedback mode is switch selectable.
- **User adjustable calibration pots:** IR compensation, min speed, max speed, forward and reverse torque, forward and reverse acceleration, and tachometer.
- **Diagnostic LEDs:** Power On light on front of enclosure. LEDs inside cover for power, forward and reverse direction, and forward and reverse current limit.
- **Stopping modes:** User can regeneratively brake (run/brake switch), coast the motor to a stop (power on/off switch) or decelerate to zero via internal jumper.

### C1RGD Series Specifications

| Models | AC Line Voltage | Output Voltage (VDC) | Cont. Output Current (ADC) | Form Factor | Hp Rating |
|---|---|---|---|---|---|
| C1RGD03-D230AC | 115/230 VAC | 0-90 or 0-180 | 3 | 1.37 | 1/20 - 1/8 @ 90 VDC<br>1/10 - 1/4 @ 180 VDC |
| C1RGD10-D230AC* | | | 10 | | 1/8 - 1 @ 90 VDC<br>1/2 - 2 @ 180 VDC |

*Needs heatsink model number 223 - 0174 above 5 amps. Drives operate from 50 - 60 Hz.

# C1RGD Series

C1RGD03-D230AC

### Typical Applications

- Conveyors
- Positioners
- Stretch Machinery
- Web Tensioning
- Cranes and Hoists
- Winders

Minarik's C1RGD Series is our low-cost solution for NEMA 1 reversing and regenerative applications. The dual AC input voltage C1RGD not only brakes and reverses brush motors on the fly, but also has more features than any other regenerative drive we have manufactured before.

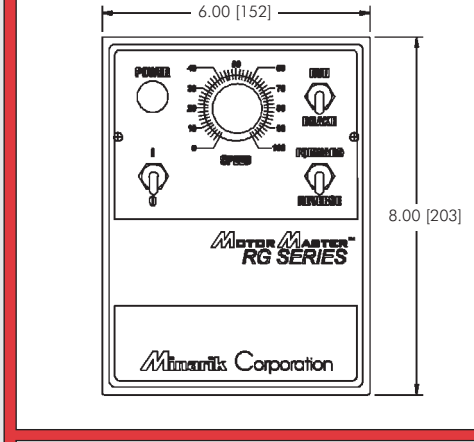
The C1RGD has the following operators conveniently mounted to the front panel: power on/off switch, run/brake switch, forward/reverse switch and speed potentiometer.

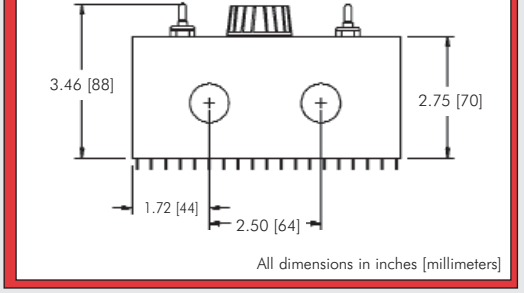
Calibrating the C1RGD is easy with the on-board trimmer pots. The deadband setting is automatically compensated for whether 50 or 60Hz power is used.

Some additional options are the PCM4 to add isolation, the DLC600 for digital control, or the 200-0386A for limit switch control.

If the application demands high performance in a NEMA 1 enclosure, the C1RGD is the answer.

### C1RGD Dimensions




All dimensions in inches [millimeters]

For matching DC motors, see pages 37 to 48.

Direct current motors are machines which produce shaft speed and torque by converting electrical power into rotating power. The speed of the motor is determined by the supply voltage and the torque is produced as a result of the current interaction with a magnetic field. The magnetic field can be produced with either electro-magnets or permanent magnets.

There are many DC motors that utilize variations of both styles. "Commutation" constantly changes the position of the rotor field in relation to the stator field to maintain the maximum amount of available force or torque that the motor can produce. To improve performance and reduce size, replace the wound field with permanent magnets. Another key advantage to the permanent magnet style, which has a constant magnetic field, is the linear relationship between speed and torque.

Minarik offers a wide variety of drives to properly control these machines, as well as motors to solve any motion control need. Once you have selected a motor based on your performance needs located on pages 38-40, match the compatibility of your motor with your Minarik drive on pages 41-44.

Page 38

## NEMA Frame SCR & PWM DC Permanent Magnet Motors

- Low profile space-saving design.
- Large over-sized brushes assure longer brush life.
- Heavy-duty, stamped steel, bolt-on base (removable).
- Rugged die cast aluminum endshields with cast iron bearing inserts.
- Permanently lubricated sealed ball bearings.

Page 39

## In-line Shaft DC Permanent Magnet Gearmotors

- 1st stage steel, balance heat treated powdered metal gearing.
- Precision machined die cast aluminum housing.
- Lifetime oil bath, sealed and gasketed.
- Hardened steel shaft.
- Face mounting, any angle.

Page 40

## Right Angle DC Permanent Magnet Gearmotors

- Suitable for horizontal or vertical mounting.
- Reversible.
- Baked enamel finish.
- Bronze gears.

# Non-Geared DC Motors

## FEATURES & BENEFITS

- Low profile space-saving design.
- Large oversized brushes assure longer life.
- Heavy-duty, stamped steel, bolt-on base (removable).
- Permanently lubricated double shielded ball bearings.
- Capable of dynamic braking for faster stops.
- Permanent magnet brush DC motors.
- Framed motors designed to operate with SCR or PWM drives powered by 115 VAC or 230 VAC input.

Select the motor which best matches your performance needs. Then check the compatibility of that motor with your Minarik drive on page 41.

# Motor Performance Data

| Motor Part Number | Motor Power [Hp] | Shaft Speed [RPM] | Continuous Torque [in-lbs] | Speed Reduction [ratio:1] | Terminal Voltage [VDC] | Rated Current (cont.) [Amps] | NEMA |
|---|---|---|---|---|---|---|---|
| 506-07-027 | 1/4 | 1750 | 9 | NA | 90* | 2.50 | LSS56C |
| 506-07-028 | 1/3 | 1750 | 12 | NA | 90* | 3.50 | MSS56C |
| 506-07-029 | 1/2 | 1750 | 18 | NA | 90* | 5.00 | NSS56C |
| 506-07-038 | 1/2 | 2500 | 12 | NA | 90* | 5.00 | LSS56C |
| 506-37-029 | 1/2 | 1750 | 18 | NA | 180** | 2.5 | NSS56C |
| 506-36-038 | 1/2 | 2500 | 12 | NA | 180** | 2.50 | 56C |
| 506-07-030 | 3/4 | 1800 | 27 | NA | 90 | 7.6 | VS556C |
| 506-37-035 | 3/4 | 1750 | 27 | NA | 180** | 3.80 | 56C |
| 506-36-039 | 3/4 | 2500 | 17 | NA | 180** | 3.80 | 56C |
| 506-06-131 | 1 | 1750 | 36 | NA | 90* | 10.0 | WLS56C |
| 506-07-040 | 1 | 2500 | 25 | NA | 90* | 10 | 56C |
| 506-36-131 | 1 | 1750 | 36 | NA | 180** | 5.00 | ZS56C |
| 506-36-140 | 1 | 2500 | 25 | NA | 180** | 5.00 | XS56C |
| 504-36-041B | 1.5 | 1750 | 52 | NA | 180** | 7.20 | 56C |
| 504-36-042B | 2 | 1750 | 72 | NA | 180** | 10.00 | 56C |
| 504-36-043B | 3 | 1750 | 108 | NA | 180** | 14.70 | 56C |

*Motor windings rated for 130 VDC
**Motor windings rated for 240 VDC

## FEATURES & BENEFITS

- Precision machined die cast aluminum.
- Oil filled, sealed and gasketed gear boxes.
- Hardened steel shaft.
- Permanent magnet brushed DC motors, TENV.
- Framed motors designed to operate with SCR or PWM drives powered by 115 VAC or 230 VAC input.

Select the motor which best matches your performance needs. Then check the compatibility of that motor with your Minarik drive on pages 43-44.

| Motor Part Number | Motor Power [Hp] | Shaft Speed [RPM] | Cont. Torque [in-lbs] | Speed Reduction [ratio:1] | Terminal Voltage [VDC] | Rated Current (cont.) [Amps] |
|---|---|---|---|---|---|---|
| 510-09-001 | 1/40 | 4 | 100 | 450 | 90* | 0.46 |
| 510-09-009 | 1/20 | 5 | 353 | 336 | 90* | 0.54 |
| 507-01-105 | 1/20 | 9 | 280 | 208 | 90* | 0.50 |
| 510-09-002 | 1/20 | 10 | 100 | 180 | 90* | 0.54 |
| 510-18-002 | 1/20 | 10 | 100 | 180 | 180** | 0.31 |
| 510-09-011 | 1/20 | 18 | 150 | 103 | 90* | 0.54 |
| 507-01-132 | 1/20 | 25 | 100 | 71.7 | 90* | 0.55 |
| 510-09-014 | 1/20 | 34 | 82 | 52 | 90* | 0.54 |
| 507-01-131 | 1/20 | 49 | 55 | 36.7 | 90* | 0.60 |
| 510-09-016 | 1/20 | 51 | 55 | 35 | 90* | 0.54 |
| 507-01-130 | 1/20 | 71 | 40 | 25.2 | 90* | 0.60 |
| 510-09-019 | 1/20 | 109 | 27 | 16 | 90* | 0.54 |
| 507-01-129 | 1/20 | 139 | 20 | 12.9 | 90* | 0.60 |
| 507-01-128 | 1/20 | 185 | 15 | 9.7 | 90* | 0.60 |
| 507-01-127 | 1/20 | 359 | 8 | 5 | 90* | 0.60 |
| 510-09-003 | 1/17 | 20 | 100 | 90 | 90* | 0.54 |
| 510-18-003 | 1/17 | 20 | 100 | 90 | 180** | 0.31 |
| 510-09-004 | 1/17 | 30 | 100 | 60 | 90* | 0.80 |
| 510-09-005 | 1/17 | 60 | 56 | 30 | 90* | 0.80 |
| 510-09-006 | 1/17 | 100 | 36 | 18 | 90* | 0.80 |
| 510-09-007 | 1/17 | 150 | 24 | 12 | 90** | 0.80 |
| 510-18-007 | 1/17 | 150 | 24 | 12 | 180** | 0.36 |
| 510-09-008 | 1/17 | 300 | 10 | 6 | 90* | 0.80 |
| 510-18-008 | 1/17 | 300 | 10 | 6 | 180** | 0.36 |
| 510-09-021 | 1/8 | 7 | 330 | 336 | 90* | 0.70 |
| 510-18-021 | 1/8 | 7 | 330 | 336 | 180** | 0.35 |
| 510-09-022 | 1/8 | 14 | 341 | 180 | 90* | 1.00 |
| 507-01-110 | 1/8 | 24 | 273 | 81.8 | 90* | 1.10 |
| 507-01-109 | 1/8 | 30 | 230 | 60.2 | 90* | 1.25 |
| 510-09-013 | 1/8 | 31 | 220 | 58 | 90* | 1.30 |
| 510-09-015 | 1/8 | 51 | 130 | 35 | 90* | 1.30 |
| 510-09-017 | 1/8 | 61 | 113 | 29 | 90* | 1.30 |
| 507-01-108 | 1/8 | 64 | 112 | 28.1 | 90* | 1.25 |
| 510-09-018 | 1/8 | 94 | 77 | 19 | 90* | 1.30 |
| 510-18-018 | 1/8 | 94 | 77 | 19 | 180** | 0.66 |
| 507-01-107 | 1/8 | 95 | 76 | 19.1 | 90* | 1.25 |
| 510-09-020 | 1/8 | 167 | 43 | 11 | 90* | 1.30 |
| 507-01-106 | 1/8 | 170 | 42 | 10.6 | 90* | 2.7 |
| 510-09-033 | 1/4 | 8 | 1087 | 212 | 90* | 2.7 |
| 510-09-035 | 1/4 | 18 | 750 | 95 | 90* | 2.7 |
| 510-18-023 | 1/4 | 21 | 371 | 124 | 180** | 0.55 |
| 510-09-025 | 1/4 | 42 | 280 | 58 | 90* | 2.30 |
| 510-18-025 | 1/4 | 42 | 280 | 58 | 180** | 1.20 |
| 510-09-037 | 1/4 | 60 | 238 | 29 | 90* | 2.7 |
| 510-18-027 | 1/4 | 62 | 220 | 43 | 180** | 1.20 |
| 510-09-038 | 1/4 | 92 | 160 | 19 | 90* | 2.7 |
| 510-09-029 | 1/4 | 125 | 100 | 23 | 90* | 2.00 |
| 510-09-031 | 1/4 | 250 | 45 | 10 | 90* | 2.00 |
| 510-09-032 | 1/4 | 500 | 25 | 5 | 90* | 2.00 |
| 510-09-041 | 1/2 | 60 | 822 | 53 | 90* | 5.0 |
| 510-09-043 | 1/2 | 135 | 476 | 29 | 90* | 5.0 |
| 510-09-045 | 1/2 | 135 | 210 | 13 | 90* | 5.0 |

*Motors windings rated for 130 VDC.
**Motor windings rated for 240 VDC.
Optional conduit box and gearmotor mounting bracket shown on page 95.

# Right Angle DC Gearmotors

## FEATURES & BENEFITS

- Precision machined die cast aluminum
- Hardened steel, forged bronze worm gear
- Hardened steel shaft
- Motor base mount any style
- Framed motors designed to operate with SCR or PWM drives powered by 115 VAC or 230 VAC input
- Permanent magnet brush DC motors, TENV

Select the motor which best matches your performance needs. Then check the compatibility of that motor with your Minarik drive on page 42.

# Motor Performance Data

| Motor Part Number | Motor Power [Hp] | Shaft Speed [RPM] | Continuous Torque [in-lbs] | Speed Reduction [ratio:1] | Terminal Voltage [VDC] | Rated Current (cont.) [Amps] |
|---|---|---|---|---|---|---|
| 511-09-047 | 1/17 | 62 | 35 | 40 | 90* | 0.68 |
| 511-09-048 | 1/17 | 125 | 20 | 20 | 90* | 0.68 |
| 511-09-049 | 1/17 | 250 | 11 | 10 | 90* | 0.68 |
| 507-02-140 | 1/15 | 30 | 68 | 60 | 90* | 0.53 |
| 507-02-139 | 1/15 | 45 | 52 | 40 | 90* | 0.53 |
| 507-02-138 | 1/15 | 59 | 41 | 30 | 90* | 0.53 |
| 507-02-128 | 1/15 | 90 | 12 | 10 | 90* | 0.53 |
| 507-02-136 | 1/15 | 115 | 26 | 15 | 90* | 0.53 |
| 507-02-135 | 1/15 | 172 | 18 | 10 | 90* | 0.53 |
| 511-18-051 | 1/12 | 42 | 30 | 60 | 180** | 0.53 |
| 511-18-054 | 1/12 | 250 | 10 | 10 | 180** | 0.53 |
| 507-02-125 | 1/8 | 40 | 88 | 45 | 90* | 1.30 |
| 511-09-056 | 1/8 | 42 | 80 | 60 | 90* | 1.40 |
| 507-02-126 | 1/8 | 60 | 72 | 30 | 90* | 1.30 |
| 511-09-057 | 1/8 | 62 | 70 | 40 | 90* | 1.40 |
| 511-18-057 | 1/8 | 62 | 70 | 40 | 180** | 0.70 |
| 507-02-003 | 1/8 | 90 | 59 | 20 | 90* | 1.30 |
| 511-09-058 | 1/8 | 125 | 45 | 20 | 90* | 1.40 |
| 507-02-002 | 1/8 | 180 | 29 | 10 | 90* | 1.30 |
| 511-18-059 | 1/8 | 250 | 25 | 10 | 180** | 0.70 |
| 511-09-060 | 1/8 | 500 | 13 | 5 | 90* | 1.40 |
| 511-09-061 | 1/4 | 62 | 135 | 40 | 90* | 2.30 |
| 511-09-063 | 1/4 | 125 | 90 | 20 | 90* | 2.30 |
| 511-09-064 | 1/4 | 250 | 50 | 10 | 90* | 2.30 |
| 511-09-065 | 1/4 | 500 | 30 | 5 | 90* | 2.30 |

*Motor windings rated for 130 VDC.
**Motor windings rated for 240VDC.
Optional conduit box and gearmotor mounting bracket shown on page 95.

| Voltage DC | 90 - 130 | | | | | | 180 - 240 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RATED HP | 1/4 | 1/3 | 1/2 | 1/2 | 1 | 1 | 1/2 | 1/2 | 3/4 | 3/4 | 1 | 1 | 1.5 | 2 | 3 |
| Minarik Drives \ Motor | 506-07-027 | 506-07-028 | 506-07-029 | 506-07-038 | 506-06-131 | 506-07-040 | 506-37-029 | 506-36-038 | 506-37-035 | 506-36-039 | 506-36-131 | 506-36-140 | 504-36-041B | 504-36-042B | 504-36-043B |
| C1RGD03-D240AC | X | X | | | | | X | X | X | X | | | | | |
| C1RGD10-D240AC | | | X | X | X | X | | | | X | X | X | X | X | |
| C1XP03-115AC-A | X | | | | | | | | | | | | | | |
| C4XL3025A | X | X | | | | | X | X | | | | | | | |
| C4XL3200A | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| M1 | X | X | X | X | H | H | | | | | | | | | |
| M2 | X | X | X | X | H | H | | | | | | | | | |
| MC10 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| MC10-R | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| MC10-PCM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| MM03115AC-PCM | | | | | | | | | | | | | | | |
| MM10-115AC-PCM | X | X | X | X | H | H | | | | | | | | | |
| MM03-230AC-PCM | | | | | | | X | X | | | | | | | |
| MM10-230AC-PCM | | | | | | | X | X | X | X | X | X | X | X | |
| MM21151C | X | | | | | | | | | | | | | | |
| MM21251C | X | | | | | | | | | | | | | | |
| MM23001C | X | X | X | X | H | H | X | X | X | X | X | X | H | H | |
| MM23002D | X | X | X | X | H | H | X | X | X | X | X | X | H | H | |
| MM23102D | X | X | X | X | H | H | X | X | X | X | X | X | H | H | |
| MM23402D | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| MM23101C | X | X | X | X | | | X | X | X | X | X | X | H | H | |
| MM23201C | X | X | X | X | X | | X | X | X | X | X | X | H | H | |
| MM23401C | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| MM301U | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| MM501U | | | | X | X | | | | | | X | X | X | X | |
| MMRG30U | X | X | X | X | H | H | | | | | | | | | |
| MMRG40U | | | | | | | X | X | X | X | X | X | H | H | |
| MMRGD03-D230AC | X | X | | | | | X | X | X | X | | | | | |
| MMRGD10-D230AC | | | X | X | X | X | | | X | X | X | X | X | X | |
| MMXL05-D240AC | X | X | X | X | X | X | X | X | X | X | X | X | | | |
| MMXL10-D240AC | | | | | H | H | | | X | X | X | X | H | | |
| NRG02-D240AC | X | | | | | | X | X | | | | | | | |
| NRG02-D240AC-2Q | X | | | | | | X | X | | | | | | | |
| NRG05-D240-2Q | X | X | X | X | | | X | X | X | X | X | X | X | X | |
| NRG05-D240AC-4Q | X | X | X | X | | | X | X | X | X | X | X | X | X | |
| NRG10-115AC-2Q | X | X | X | X | X | X | | | | | | | | | |
| NRG10-115AC-4Q | X | X | X | X | X | X | | | | | | | | | |
| PCM21000A | X | X | X | X | H | H | | | | | | | | | |
| PCM23001A | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| PCMXP05-115AC | X | X | X | X | | | | | | | | | | | |
| PCMXP10-115AC | X | X | X | X | | | | | | | | | | | |
| RG500A | | | X | X | X | X | X | X | X | X | X | X | X | X | |
| RG500UA | X | X | X | X | H | H | X | X | X | X | X | X | H | H | |
| RG60U, RG60U-T | X | X | X | X | H | H | X | X | X | X | X | X | X | X | |
| RGT300U | X | X | X | X | H | H | | | | | | | | | |
| RGT400U | | | | | | | X | X | X | X | X | X | X | H | |
| XL3025A | X | | | | | | | | | | | | | | |
| XL3050A | X | X | X | X | | | X | X | X | X | | | | | |
| XL3200A | X | X | X | X | H | H | X | X | X | X | X | X | X | X | |
| XL3300A | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| XP05-115AC | X | X | X | X | | | | | | | | | | | |
| XP10-115AC | | | | | | | | | | | | | | | |
| XP32-12/24DC | X | | | | | | | | | | | | | | |
| XP03-115AC-SL | X | | | | | | | | | | | | | | |

X = Standard model H = Must be used with a heatsink S = Special configuration of a standard model (call for part #).

# Right Angle DC Gearmotors

## Compatibility Chart

| Voltage DC | 90 - 130 | | | | | | | | 180-240 | | 90-130 | | | | | | | 180-240 | | 90-130 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RATED HP | 1/17 | | | 1/15 | | | | | 1/12 | | 1/8 | | | | | | | 1/8 | | 1/4 | | | |
| Motor / Minarik Drives | 511-09-047 | 511-09-048 | 511-09-049 | 507-02-128 | 507-02-135 | 507-02-136 | 507-02-138 | 507-02-139 | 507-02-140 | 511-18-051 | 511-18-054 | 507-02-002 | 507-02-003 | 507-02-126 | 511-09-056 | 511-09-057 | 511-09-058 | 511-09-060 | 511-18-057 | 511-18-059 | 511-09-061 | 511-09-063 | 511-09-064 | 511-09-065 |
| C1RGD03-D240AC | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| C1RGD10-D230AC | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| C1XP01-115AC-A | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | |
| C1XP03-115AC-A | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| C4XL3025 | X | X | X | X | X | X | X | X | X | | | | | | | | | | X | X | X | X | X | X |
| C4XL3200A | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| M1 | | | | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | X | X | X | X |
| M2 | | | | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MC10 | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MC10-R | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MC10-PCM | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM03-115AC-PCM | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| MM10-115AC-PCM | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM03-230AC-PCM | | | | | | | | | | X | X | | | | | | | | X | X | | | | |
| MM10-230AC-PCM | | | | | | | | | | | | | | | | | | | | | | | | |
| MM21111A | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| MM21151C | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM21211A | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| MM21251C | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM23001C | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM23002D | | | | | | | | | | | | X | X | X | X | X | X | X | | | | X | X | X |
| MM23012D | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MM23112D | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MM23212D | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MM23412D | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MM23102D | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM23402D | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM23011C | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MM23101C | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM23201C | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM23401C | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MM23411C | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MM301U | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| MM311U | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MMRG30U | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MMRG31U | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| MMRGD03-D230AC | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | | X | X | | | | |
| MMRGD10-D230AC | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| MMXL02-D240AC | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| MMXL05-D240AC | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| NRG02-D240AC-2Q | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| NRG02-D240AC-4Q | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| NRG05-D240AC-2Q | | | | | | | | | | | | | | | | | | | | | | | | |
| NRG05-D240AC-4Q | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| NRG10-115AC-2Q | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| NRG10-115AC-4Q | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| PCM21000A | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| PCM21010A | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| PCM23001A | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| PCM23401A | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| PCM23411A | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| PCMXP02-115AC | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| PCMXP05-115AC | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| RG500A | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| RG500UA | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| RG501A | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| RG510A | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| RG510UA | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| RG511A | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | | | | |
| RG60U, RG60U-T | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| RGT300U | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| RGT310U | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| XL3025A | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| XL3050A | | | | | | | | | | | | X | X | X | X | X | X | X | | | X | X | X | X |
| XL3200A | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| XL3300A | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| XP02-115AC | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | | | | |
| XP02-115AC-Q | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | X | X | X | X |
| XP05-115AC | | | | | | | | | | | | | | | | | | | | | X | X | X | X |
| XP03-115AC-SL | X | X | X | X | X | X | X | X | X | | | X | X | X | X | X | X | X | | | X | X | X | X |

X = Standard model



Minarik DRIVES
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| Voltage DC | 90 - 130 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RATED HP | 1/40 | 1/20 | | | | | | | | | | | | | 1/17 | | | | | | 1/8 | | | | | | | | | |
| Motor / Minarik Drives | 510-09-001 | 507-01-105 | 507-01-127 | 507-01-128 | 507-01-129 | 507-01-130 | 507-01-131 | 507-01-132 | 510-09-002 | 510-09-009 | 510-09-011 | 510-09-014 | 510-09-016 | 510-09-019 | 510-09-003 | 510-09-004 | 510-09-005 | 510-09-006 | 510-09-007 | 510-09-008 | 507-01-106 | 507-01-107 | 507-01-108 | 507-01-109 | 507-01-110 | 510-09-013 | 510-09-015 | 510-09-017 | 510-09-018 | 510-09-020 | 510-09-021 | 510-09-022 |
| C1RGD03-D240AC | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| C1RGD10-D230AC | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| C1XP01-115AC-A | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | |
| C1XP03-115AC-A | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| C4XL3025 | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| C4XL3200A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M1, M2 | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MC10, MC10-R | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MC10-PCM | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM03-115AC-PCM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM10-115AC-PCM | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM03-230AC-PCM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MM10-230AC-PCM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MM21111A | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM21151C | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM21211A | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM21251C | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM23001C | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM23002D | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM23012D | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM23112D | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM23212D | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM23412D | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM23102D | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM23402D | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM23011C | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM23101C | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM23201C | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM23401C | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MM23411C | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MM301U | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MM311U | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MMRG30U | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MMRG31U | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MMRGD03-D230AC | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MMRGD10-D230AC | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| MMXL02-D240AC | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MMXL05-D240AC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NRG02-D240AC-2Q | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| NRG02-D240AC-4Q | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| NRG05-D240AC-2Q | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| NRG05-D240AC-4Q | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| NRG10-115AC-2Q | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NRG10-115AC-4Q | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PCM21000A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PCM21010A | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| PCM23001A | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| PCM23401A | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| PCM23411A | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| PCMXP02-115AC | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| PCMXP05-115AC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG500A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG500UA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG501A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RG510A | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| RG510UA | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| RG511A | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| RG60U, RG60U-T | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| RGT300U | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RGT310U | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| XL3025A | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| XL3050A | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X |
| XL3200A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| XL3300A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| XP02-115AC | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| XP02-115AC-Q | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| XP05-115AC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| XP01-115AC-SL | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| XP03-115AC-SL | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

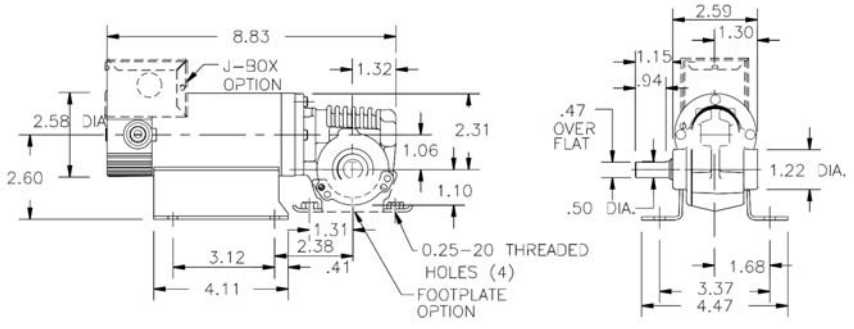
X = Standard Model

# Compatibility Chart

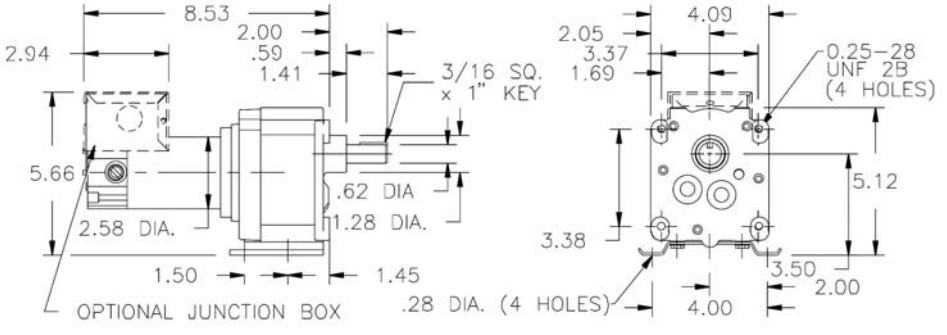


| Voltage DC | 90 - 130 | | | | | | | | | | | | | 180 - 240 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RATED HP | 1/4 | | | | | | | | | | 1/20 | 1/17 | | | 1/8 | | | 1/4 | | | | |
| Minarik Drives / Motor | 510-09-024 | 510-09-025 | 510-09-029 | 510-09-031 | 510-09-032 | 510-09-033 | 510-09-034 | 510-09-035 | 510-09-037 | 510-09-038 | 510-18-002 | 510-18-003 | 510-18-007 | 510-18-008 | 510-18-015 | 510-18-018 | 510-18-020 | 510-18-023 | 510-18-025 | 510-18-027 | 510-18-029 | 510-18-030 | 510-18-032 |
| C1RGD03-D240AC | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| C1RGD10-D230AC | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| C1XP01-115AC-A | | | | | | | | | | | | | | | | | | | | | | | |
| C1XP03-115AC-A | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| C4XL3025 | X | X | X | X | X | X | X | X | X | X | | | | | X | X | X | X | X | X | X | X | X |
| C4XL3200A | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MC10 | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MC10-R, MC10-PCM | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| M1, M2 | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| MM03-115AC-PCM | | | | | | | | | | | | | | | | | | | | | | | |
| MM10-115AC-PCM | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| MM03-230AC-PCM | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MM10-230AC-PCM | | | | | | | | | | | | | | | | | | X | X | X | X | X | X |
| MM21111A | | | | | | | | | | | | | | | | | | | | | | | |
| MM21151C | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| MM21211A | | | | | | | | | | | | | | | | | | | | | | | |
| MM21251C | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| MM23001C | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MM23002D | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MM23012D | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MM23112D | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MM23212D | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MM23412D | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MM23102D | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MM23402D | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MM23011C | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MM23101C | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MM23201C | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MM23401C | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| MM23411C | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MM301U | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| MM311U | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MMRG30U | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| MMRG31U | | | | | | | | | | | | | | | | | | | | | | | |
| MMRGD03-D230AC | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MMRGD10-D230AC | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| MMXL02-D240AC | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| MMXL05-D240AC | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| NRG02-D240AC-2Q | X | X | X | X | X | X | X | X | X | X | | | | | X | X | X | X | X | X | X | X | X |
| NRG02-D240AC-4Q | X | X | X | X | X | X | X | X | X | X | | | | | X | X | X | X | X | X | X | X | X |
| NRG05-D240AC-2Q | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| NRG05-D240AC-4Q | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| NRG10-115AC-2Q | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| NRG10-115AC-4Q | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| PCM21000A | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| PCM21010A | | | | | | | | | | | | | | | | | | | | | | | |
| PCM23001A | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| PCM23401A | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| PCM23411A | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| PCMXP02-115AC | | | | | | | | | | | | | | | | | | | | | | | |
| PCMXP05-115AC | X | X | | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| RG500A | X | X | | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| RG500UA | X | X | | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| RG501A | X | X | | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| RG510A | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| RG510UA, RG511A | | | | | | | | | | | | | | | | | | | | | | | |
| RG60U, RG60U-T | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| RGT300U | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| RGT310U | | | | | | | | | | | | | | | | | | | | | | | |
| XL3025A | X | X | X | X | X | X | X | X | X | X | | | | | X | X | X | X | X | X | X | X | X |
| XL3050A | X | X | X | X | X | X | X | X | X | X | | | | | | | | X | X | X | X | X | X |
| XL3200A | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| XL3300A | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| XP02-115AC | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| XP02-115AC-Q | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| XP05-115AC | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |
| XP01-115AC-SL | | | | | | | | | | | | | | | | | | | | | | | |
| XP03-115AC-SL | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | |

## Dimensions

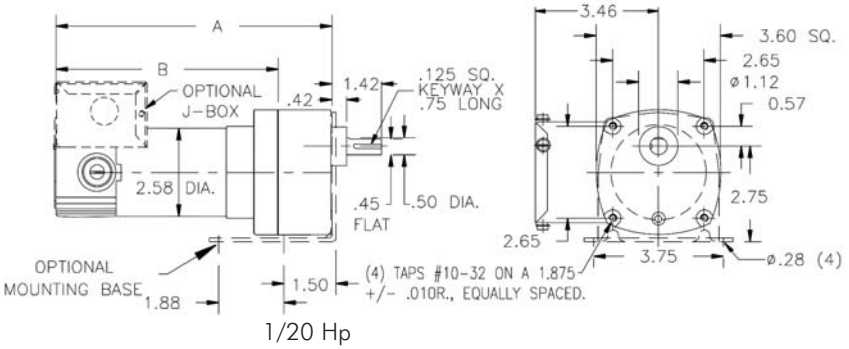



1/15 Hp
507-02-128, 135, 136, 138, 139, 140




1/20 Hp
507-01-105

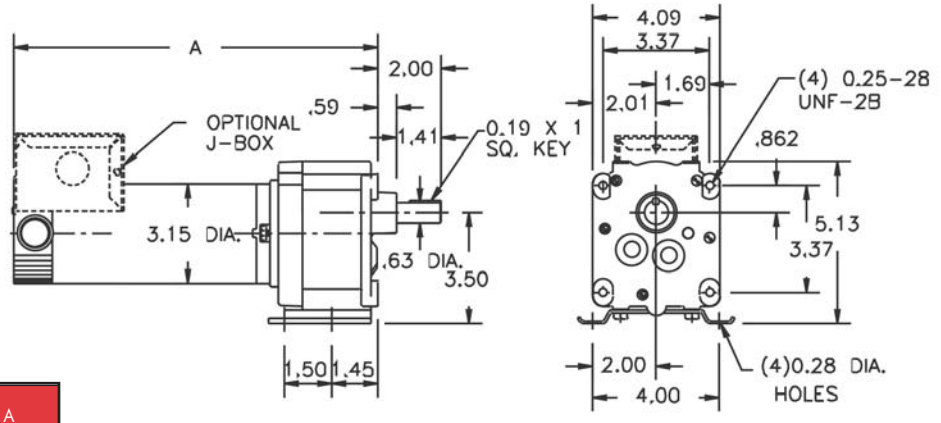
| Model Number | A | B |
|---|---|---|
| 507-01-127 | 7.38 | 6.48 |
| 507-01-128 | 7.38 | 6.48 |
| 507-01-129 | 7.38 | 6.48 |
| 507-01-130 | 7.38 | 6.48 |
| 507-01-131 | 7.38 | 6.48 |
| 507-01-132 | 7.38 | 6.48 |




1/20 Hp
507-01-127, 128, 129, 130, 131, 132

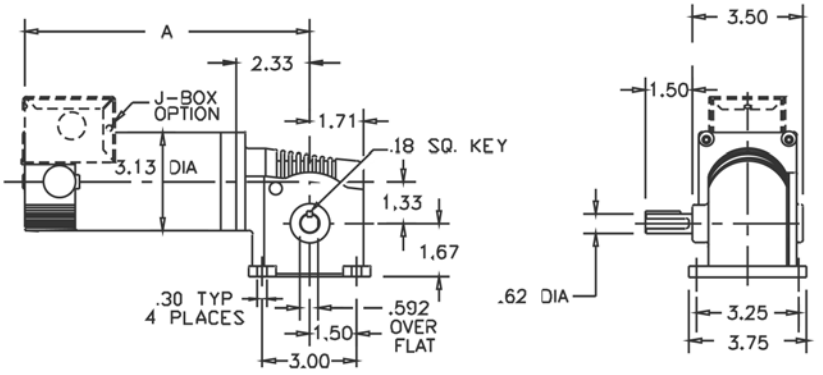
All dimensions in inches [millimeters]

## Dimensions




| Model Number | A |
|---|---|
| 507-01-106 | 10.4 |
| 507-01-107 | 10.4 |
| 507-01-108 | 10.4 |
| 507-01-109 | 10.4 |
| 507-01-110 | 10.4 |

1/8 Hp
507-01-106, 107, 108, 109, 110

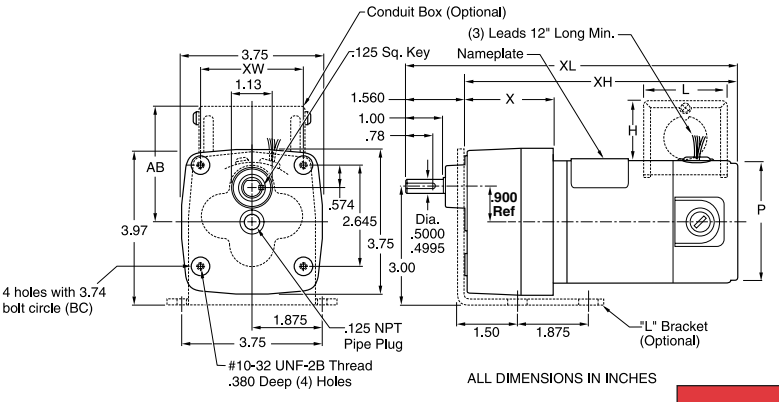



| Model Number | A |
|---|---|
| 507-02-002 | 9.36 |
| 507-02-003 | 9.36 |
| 507-02-125 | 9.36 |
| 507-02-126 | 9.36 |

1/8 Hp
507-02-002, 003, 125, 126

All dimensions in inches [millimeters]

## Dimensions

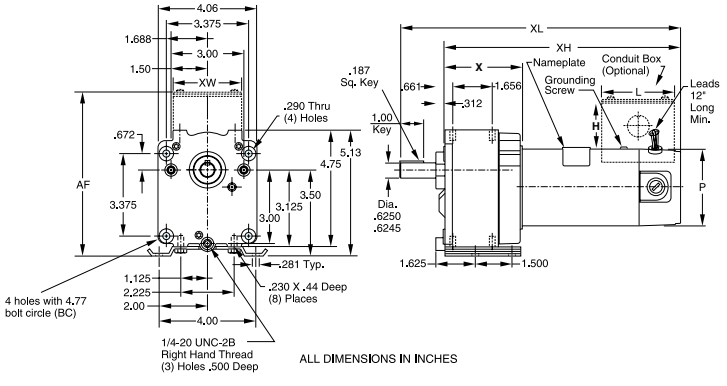



ALL DIMENSIONS IN INCHES

CONDUIT BOX DIMENSIONS (IN.)

| FRAME DIA. | CONDUIT BOX P/N | XW | AB | H | L |
|---|---|---|---|---|---|
| 2.38 | 221-0997 | 2.50 | 3.00 | 1.80 | 2.14 |
| 3.00 | 221-0993 | 2.63 | 3.47 | 1.90 | 3.13 |
| 3.11 | 221-0993 | 2.63 | 3.47 | 1.90 | 3.13 |

| Model Number | P | X | XL | XH |
|---|---|---|---|---|
| | Inches | | | |
| 510-09-001 | 2.38 | 3.25 | 8.33 | 6.21 |
| 510-09-002 | 3.00 | 3.25 | 9.28 | 7.16 |
| 510-18-002 | 3.11 | 3.25 | 9.30 | 7.18 |
| 510-09-003 | 3.00 | 3.25 | 9.28 | 7.16 |
| 510-18-003 | 3.11 | 3.25 | 9.30 | 7.18 |
| 510-09-004 | 3.11 | 2.68 | 8.74 | 6.62 |
| 510-09-005 | 3.11 | 2.68 | 8.74 | 6.62 |
| 510-09-006 | 3.11 | 2.68 | 8.74 | 6.62 |
| 510-09-007 | 3.11 | 2.40 | 8.46 | 6.34 |
| 510-18-007 | 3.11 | 2.40 | 8.46 | 6.34 |
| 510-09-008 | 3.11 | 2.40 | 8.46 | 6.34 |
| 510-18-008 | 3.11 | 2.40 | 8.46 | 6.34 |



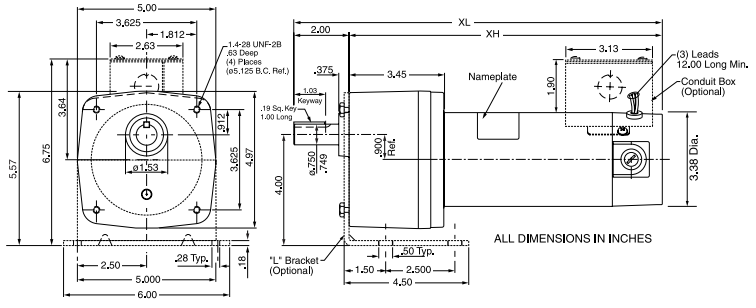

ALL DIMENSIONS IN INCHES

CONDUIT BOX DIMENSIONS (IN.)

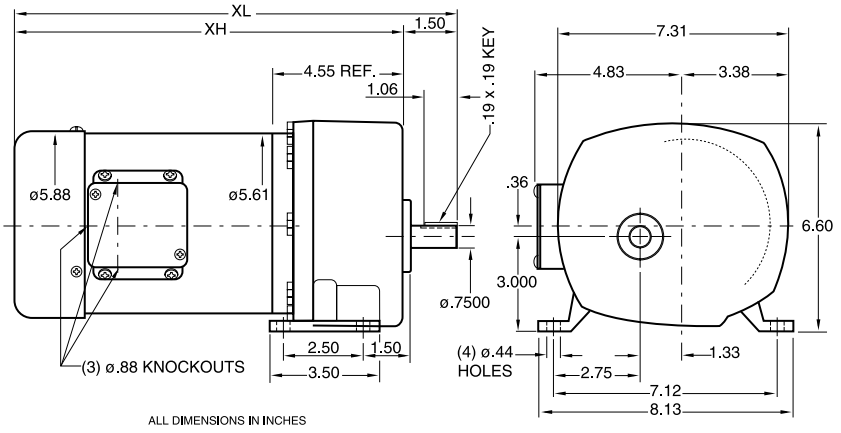
| FRAME DIA. | CONDUIT BOX P/N | AF | XW | H | L |
|---|---|---|---|---|---|
| 3.00 | 221-0993 | 6.26 | 2.63 | 1.90 | 3.13 |
| 3.11 | 221-0993 | 6.26 | 2.63 | 1.90 | 3.13 |

| Model Number | P | X | XL | XH |
|---|---|---|---|---|
| | Inches | | | |
| 510-09-009 | 3.00 | 3.45 | 10.07 | 8.26 |
| 510-09-011 | 3.00 | 3.54 | 10.07 | 8.26 |
| 510-09-013 | 3.11 | 3.23 | 11.54 | 9.73 |
| 510-09-014 | 3.00 | 3.54 | 10.07 | 8.26 |
| 510-09-015 | 3.11 | 3.23 | 11.54 | 9.73 |
| 510-09-016 | 3.00 | 3.54 | 10.07 | 8.26 |
| 510-09-017 | 3.11 | 3.23 | 11.54 | 9.73 |
| 510-09-018 | 3.11 | 3.23 | 11.54 | 9.73 |
| 510-18-018 | 3.11 | 3.23 | 11.54 | 9.73 |
| 510-09-019 | 3.11 | 3.54 | 10.07 | 9.73 |
| 510-09-018 | 3.11 | 3.23 | 11.54 | 9.73 |

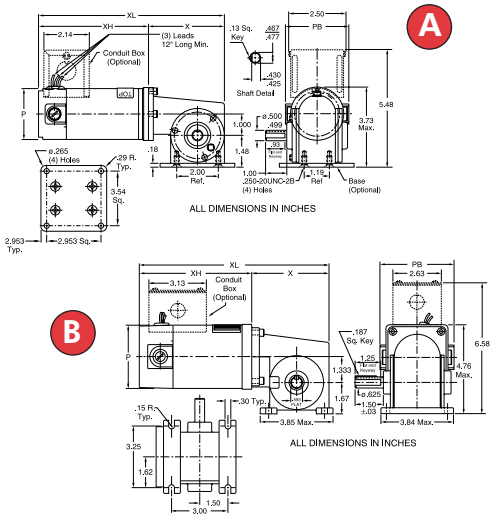
## Dimensions




| Model Number | XL | XH |
|---|---|---|
| | Inches | |
| 510-09-021 | 11.31 | 9.31 |
| 510-18-021 | 11.31 | 9.31 |
| 510-09-022 | 11.31 | 9.31 |
| 510-18-023 | 13.31 | 11.31 |
| 510-09-025 | 13.31 | 11.31 |
| 510-18-025 | 13.31 | 11.31 |
| 510-18-027 | 13.31 | 11.31 |
| 510-09-029 | 13.31 | 11.31 |
| 510-09-031 | 13.31 | 11.31 |
| 510-09-032 | 13.31 | 11.31 |




| Model Number | XL | XH |
|---|---|---|
| | Inches | |
| 510-09-033 | 14.40 | 12.90 |
| 510-09-035 | 14.40 | 12.90 |
| 510-09-037 | 14.40 | 12.90 |
| 510-09-038 | 14.40 | 12.90 |
| 510-09-041 | 16.72 | 15.22 |
| 510-09-043 | 16.72 | 15.22 |
| 510-09-045 | 16.72 | 15.22 |




| Model Number | Dim dwg. | P | PB | X | XL | XH |
|---|---|---|---|---|---|---|
| 511-09-047 | A | 2.38 | 3.00 | 3.60 | 8.79 | 5.19 |
| 511-09-048 | A | 2.38 | 3.00 | 3.60 | 8.79 | 5.19 |
| 511-09-049 | A | 2.38 | 3.00 | 3.60 | 8.79 | 5.19 |
| 511-18-051 | B | 3.38 | 4.00 | 4.50 | 9.64 | 5.14 |
| 511-18-054 | B | 3.38 | 4.00 | 4.50 | 9.64 | 5.14 |
| 511-09-056 | B | 3.38 | 4.00 | 4.50 | 10.64 | 6.14 |
| 511-09-057 | B | 3.38 | 4.00 | 4.50 | 10.64 | 6.14 |
| 511-18-057 | B | 3.38 | 4.00 | 4.50 | 10.64 | 6.14 |
| 511-09-058 | B | 3.38 | 4.00 | 4.50 | 10.64 | 6.14 |
| 511-18-059 | B | 3.38 | 4.00 | 4.50 | 10.64 | 6.14 |
| 511-09-060 | B | 3.38 | 4.00 | 4.50 | 10.64 | 6.14 |
| 511-09-061 | B | 3.38 | 4.00 | 4.50 | 12.64 | 8.14 |
| 511-09-064 | B | 3.38 | 4.00 | 4.50 | 12.64 | 8.14 |
| 511-09-065 | B | 3.38 | 4.00 | 4.50 | 12.64 | 8.14 |

Minarik now offers 3-phase induction motors that are wound for either 230 VAC or 115 VAC input. Our Delta-Wave (AC) induction motors use three phases of alternating current supplied to the stator to provide the speed and torque necessary for your motion control needs. These currents rise and fall in polarity much like an ocean wave. The waves circulate around the stator core at a frequency determined by the user and a drive such as our variable frequency MAC drive. The rotor of the AC motor consists of multiple current paths (coils) integrated throughout an iron core. This rotor construction is typically known as a squirrel cage design. Reaction between stator and rotor coils result by transformer action across the stator/rotor air gap. The induction motor is essentially a transformer with a rotating secondary. The force that exists between primary and secondary coils in a transformer appears as useful torque in an induction motor. The rotor is pushed into rotation by the ensuing stator wave. The frequency of the waves establishes the maximum speed but it does not provide the torque necessary to run at that speed. The voltage and resulting current provide the actual power to do the work.

$$RPM = (120 \times Hz)/Poles$$

The stator field rotates at a speed determined by the frequency and number of poles. The rotor always turns at a lower speed than the stator fields; if the rotor turned at a synchronous speed, there would be no change in flux linkage, no induced current, and no torque. The small difference in speed that produces flux cutting and motor action is called the slip.

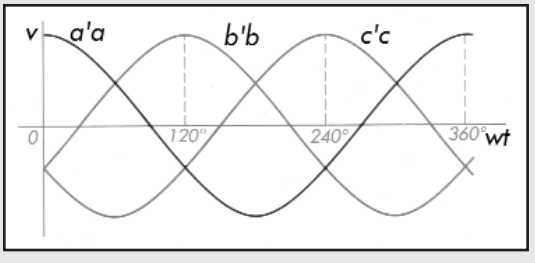
By definition percent slip is:

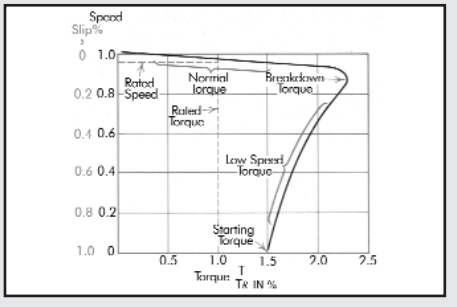
$$s = (N_{stator} - N_{slip}) / N_{stator}) \times 100$$

The output shaft speed is :

$$N_{rotor} = N_{sync} - (N_{sync}{}^{x5})$$

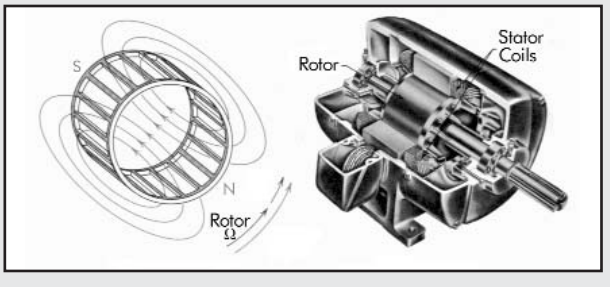
Our MAC drive accepts either 115 VAC or 230 VAC input and provides respective 3 phase PWM output for these induction motors. The PWM output gives us a high dynamic response for high performance use, a very wide speed range (up to 100:1), and smooth motor control through zero speed. The frequency range can be varied from 3 to 400 Hz with constant torque available up to 60 Hz, and constant horsepower available above 60 Hz. The drive features solid-state reversing with adjustable acceleration and deceleration. They also feature adjustable current limit and $I^2T$ class 10 current trip to protect the motor, thermal protection, line starting and stopping, min. and max. speed control, slip compensation, acceleration torque boosting control, and many more features. Standard models are available to power induction motors up to 1 Hp.




## AC Solutions

The key advantages of this motor design vs. the permanent magnet brush or permanent magnet BLDC motor line is simplicity, reliability, and durability. Positional feedback and high energy rare earth magnets are not necessary with this type of machine. Users may take advantage of standard power lines and wall outlets offering 115 VAC or 230 VAC. The complexity of these past machines did not come from the motor, but the control of that motor. Minarik has developed the ideal economical drive solution to this dilemma with the aforementioned MAC drive. This drive gives you complete control of our Delta-Wave motors as well as any three phase induction motor.




Minarik's system solution approach is ideal for applications involving web handling, conveyors, fans, blowers, pumps, compressors, stirring machines, etc. Contact a Minarik representative to find out more about our AC solutions for your application.

NEW

# 1/2 to 1.5HP
# Isolated PWM AC Chassis

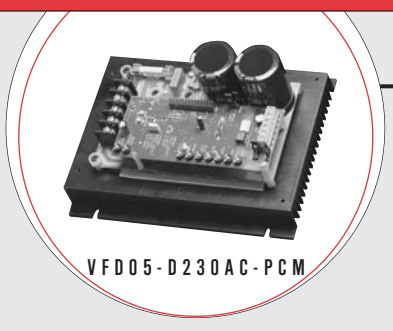


## FEATURES & BENEFITS

- **Compact size:** Chassis unit is small and easy to mount.
- **Isolated inputs:** Accepts floating or grounded signals 0-10VDC, 0-5VDC or 4-20mA.
- **Control a variety of motors:** 3-phase induction motors, single-phase permanent split capacitor (PSC), shaded pole and synchronous motors.
- **User adjustable calibration pots:** Minimum speed, maximum speed, current limit, acceleration, deceleration, slip compensation, boost, zero set, brake current, and brake time.
- **Diagnostic LED's:** Power, Fault, and Torque limit.
- **Stopping modes:** DC injection braking or coast (jumper selectable).
- **Adjustable 4 to 16kHz switching frequency:** Quiet motor operation or reduced electrical noise.
- **Quick disconnect terminal block:** Allows for quick and easy terminations and changes.
- **Torque "foldback":** Allows up to 200% torque to overcome intermittent peak loads.
- **Additional features:** Auto or manual restart after low input voltage fault (jumper selectable), line fusing, enable and direction inputs.

| Model Number | Input Voltage ±10%, 1 phase 50/60 Hz | Output Voltage | Output Current (A) | Max Output Frequency | Hp Rating | Enclosure Type |
|---|---|---|---|---|---|---|
| VFD05-D230AC-PCM | 115 or 230VAC | 0-230VAC | 5 | 0-120Hz | 1/2-1.5 | Chassis |

# VFD05-PCM Series



VFD05-D230AC-PCM

## Typical Applications

- Conveyors
- Material Handling
- Packaging Machinery
- Sorting Machinery
- Door and Gate Openers
- Food Packaging Machinery

The Volts/Hertz, PWM, VFD05-D230AC-PCM has all the features of the original VFD series with several additional enhancements. They include an isolated front end, minimum speed adjustment potentiometer (pot), output voltage doubling, DC injection braking, and automatic or manual restart when power is restored.

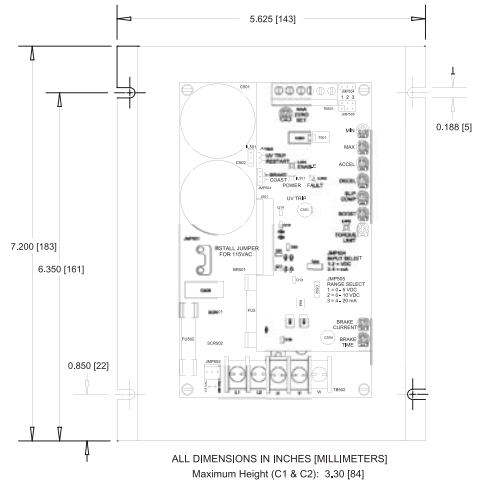
The VFD-PCM series accepts reference signals that are 0-5V, 0-10V or 4-20mA without an additional isolation card. The DC injection braking feature comes with two additional calibration potentiometers (Braking Current and Braking Time) for easy set up.

The dual voltage VFD-PCM inverters have a “doubling” jumper that can be set to output 230VAC to the motor when only 115VAC is available. Another jumper selectable option is for automatic or manual restarting.

Many applications require an inverter to be able to automatically re-start itself in the event of a power loss. If automatic restart is selected, then after a low voltage fault, the inverter will restart itself when the input voltage is restored to a minimum level.

The features, flexibility and compact size of the VFD05-D230AC-PCM series makes it an ideal choice for most AC motor applications under 1.5 horsepower

## VFD05-D230AC-PCM Dimensions




For matching AC motors, see pages 61 to 66.

## FEATURES & BENEFITS

- **NEMA 4X:** Aluminum, compact, easy to mount. Choose gray or USDA rated white epoxy.
- **Isolated inputs:** Accepts floating or grounded signals 0-10VDC, 0-5VDC or 4-20mA.
- **Control a variety of motors:** 3-phase induction motors, single-phase permanent split capacitor (PSC), shaded pole and synchronous motors.
- **User adjustable calibration pots:** Minimum speed, maximum speed, current limit, acceleration, deceleration, slip compensation, boost, zero set, brake current, and brake time.
- **Diagnostic LED's:** Power, Fault, Enable and Torque limit.
- **Stopping modes:** DC injection braking or coast (jumper selectable).
- **Adjustable 4 to 16kHz switching frequency:** Quiet motor operation or reduced electrical noise.
- **Quick disconnect terminal block:** Allows for quick and easy terminations and changes.
- **Torque "foldback":** Allows up to 200% torque to overcome intermittent peak loads.
- **Additional features:** Auto or manual restart after low input voltage fault (jumper selectable), line fusing, enable and direction inputs.

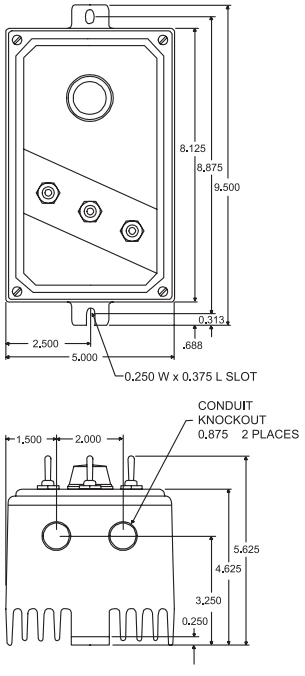
| Model Number | Input Voltage ±10%, 1 phase 50/60 Hz | Output Voltage | Output Current (A) | Max Output Frequency | Hp Rating | Enclosure Type |
|---|---|---|---|---|---|---|
| VFDA4X04-D230AC-PCM | 115 or 230VAC | 0-230VAC | 4 | 0-120Hz | 1/6-1 | NEMA 4X (gray aluminum) |
| VFDF4X04-D230AC-PCM | 115 or 230VAC | 0-230VAC | 4 | 0-120Hz | 1/6-1 | NEMA 4X (white epoxy, USDA rated) |

# VFDA4X04-PCM Series

## Typical Applications

- Conveyors
- Material Handling
- Packaging Machinery
- Sorting Machinery
- Food Packaging Machinery
- Pumps and Mixers

## VFDA4X04-D230AC -PCM Dimensions




For matching AC motors, see pages 61 to 66.

The Volts/Hertz, PWM, VFDA4X04-D230AC-PCM and VFD4X04-D230AC-PCM have all the features of the original VFD series with several enhancements. They include a rugged aluminum NEMA 4X enclosure, an isolated front end, minimum speed adjustment potentiometer (pot), output voltage doubling, DC injection braking, and automatic or manual restart when power is restored. The VFDF4X04-D230AC-PCM enclosure is painted in a white epoxy and is USDA rated-perfect for food environments!

The VFD-PCM series accepts reference signals that are 0-5V, 0-10V or 4-20mA without an additional isolation card. The DC injection braking feature comes with two additional calibration potentiometers (Braking Current and Braking Time) for easy set up.

The dual voltage VFD-PCM series has a "doubling" jumper that can be set to output 230VAC to the motor when only 115VAC is available. Another jumper selectable option is for choosing automatic or manual restarting.

The features, flexibility and compact size of the VFDA4X04-D230-PCM and VFDF4X04-D230AC-PCM make it the ideal choice for AC motor applications under 1 horsepower in adverse surroundings.

NEW

# 1/6 to 1 HP
# Isolated PWM AC NEMA 4X



## FEATURES & BENEFITS

- **NEMA 4X enclosure:** Compact, easy to mount, black plastic enclosure.
- **Isolated inputs:** Accepts floating or grounded signals 0-10VDC, 0-5VDC or 4-20mA.
- **Control a variety of motors:** 3-phase induction motors, single-phase permanent split capacitor (PSC), shaded pole and synchronous motors.
- **User adjustable calibration pots:** Minimum speed, maximum speed, current limit, acceleration, deceleration, slip compensation, boost, zero set, brake current, and brake time.
- **Diagnostic LED's:** Power, Fault, and Torque limit.
- **Stopping modes:** DC injection braking or coast (jumper selectable).
- **Adjustable 4 to 16kHz switching frequency:** Quiet motor operation or reduced electrical noise.
- **Quick disconnect terminal block:** Allows for quick and easy terminations and changes.
- **Torque "foldback":** Allows up to 200% torque to overcome intermittent peak loads.
- **Additional features:** Auto or manual restart after low input voltage fault (jumper selectable), line fusing, enable and direction inputs.

| Model Number | Input Voltage ±10%, 1 phase 50/60 Hz | Output Voltage | Output Current (A) | Max Output Frequency | Hp Rating | Enclosure Type |
|---|---|---|---|---|---|---|
| VFDP4X04-D230AC-PCM | 115 or 230VAC | 0-230VAC | 4 | 0-120 Hz | 1/6-1 | NEMA 4X (black plastic) |

# VFDP4X04-PCM Series

VFDP4X04-D230AC-PCM

## Typical Applications

- Conveyors
- Material Handling
- Packaging Machinery
- Sorting Machinery
- Door and Gate Openers
- Food Packaging Machinery

The Volts/Hertz, PWM, VFDP4X04-D230AC-PCM has all the features of the original VFD series with several additional enhancements. They include a lightweight, plastic NEMA 4X enclosure, an isolated front end, minimum speed adjustment potentiometer (pot), output voltage doubling, DC injection braking, and automatic or manual restart when power is restored.

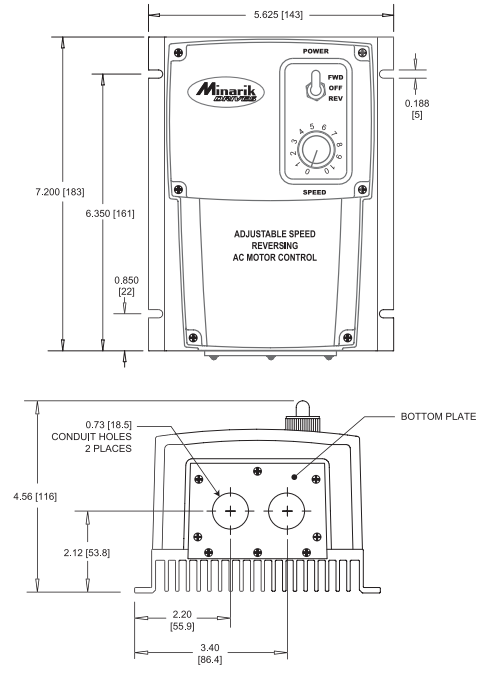
The VFDP4X04-D230AC-PCM accepts reference signals that are 0-5V, 0-10V or 4-20mA without an additional isolation card. The DC injection braking feature comes with two additional calibration potentiometers (Braking Current and Braking Time) for easy set up.

The dual voltage VFDP4X04-D230AC-PCM has a "doubling" jumper that can be set to output 230VAC to the motor when only 115VAC is available. Another jumper selectable option is for choosing automatic or manual restarting.

Many applications require an inverter to be able to automatically re-start itself in the event of a power loss. If automatic restart is selected, then after a low voltage fault, the inverter will restart itself when the input voltage is restored to a minimum level.

The features, flexibility and compact size of the VFDP4X04-D230AC-PCM make it the ideal choice for AC motor applications under 1 horsepower where the drive will be mounted in adverse surroundings.

## VFDP4X-PCM Dimensions




ALL DIMENSIONS IN INCHES [MILLIMETERS]

For matching AC motors, see pages 61 to 66.

## FEATURES & BENEFITS

- **Compact size:** (4.30" x 3.70") Easy to mount in small spaces with industry standard mounting hole pattern.
- **"D" models can double the output:** Enables the use of a 230 VAC motor with a 115 VAC power supply.
- **Use with a variety of motors:** Can be used with 3-phase induction and single-phase permanent split capacitor, shaded pole and synchronous motors. Quickly and easily change trimmer pot ranges for 1/4 to 1 hp motors.
- **Easy to calibrate & set-up:** On-board trimmer pot adjustments for boost, maximum speed, acceleration, deceleration, and torque limit.
- **Torque 'foldback' feature:** Allows up to 200% torque for short periods to overcome intermittent peak loads, then reduces the torque to a (preset) safe level.
- **16kHz switching frequency, with option to change between 4 and 16 kHz in the field:** A high switching frequency results in quiet motor operation. Adjustments to a lower frequency if desired can be done in the field.
- **Optional isolation:** Order unit with a -PCM suffix for isolation of inputs

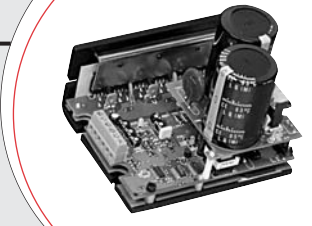
## VFD Series Specifications

| | VFD01-230AC | VFD01-D230AC | VFD02-115AC | VFD02-230AC | VFD02-D230AC | VFD04-115VAC | VFD04-230AC | VFD04-D230AC |
|---|---|---|---|---|---|---|---|---|
| Input Voltage ±10%, 1-phase | 230VAC | 115 or 230 VAC | 115VAC | 230VAC | 115 or 230 VAC | 115VAC | 230VAC | 115 or 230 VAC |
| Nominal Output Voltage | 0 - 230V | 0 - 230V | 0 - 115V | 0 - 230V | 0 - 230V | 0 - 115V | 0 - 230V | 0 - 230V |
| Maximum Continuous Output Current | 1.2A rms | 1.2A rms | 2.4A rms | 2.4A rms | 2.4A rms | 4.0A rms | 4.0A rms | 4.0A rms |
| Max Horsepower | 1/4 | 1/4 | 1/4 | 1/2 | 1/2 | 1/2 | 1 | 1 |
| Height | 2.03 [51.6] | 2.56 [65.0] | 2.68 [68.1] | 2.48 [63.0] | 3.02 [76.7] | 3.68 [93.5] | 3.68 [93.5] | 4.45 [113] |

# VFD Series

### Typical Applications

- Pumps and Mixers
- Sorting Machinery
- Packaging Machinery
- Fans
- Door and Gate Openers



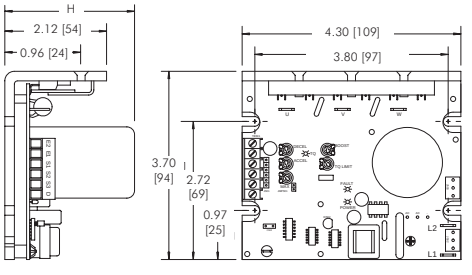
VFD04-230AC

The Volts/Hertz VFD Series has several models in the 1/4 - 1 hp range that accepts 115 VAC and 230 VAC power. The cost-conscious and compact chassis design of the VFD Series maintains the industry standard for mounting hole location and the coded LEDs make it easy to visually determine the drive status. Dual voltage "D" versions have a jumper that causes the drive to output double the voltage, allowing the use of 230VAC motors when only a 115 VAC power supply is available.

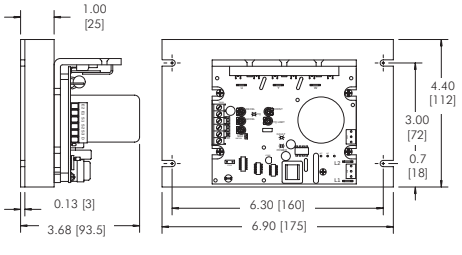
The unique torque "foldback" feature protects your motor and equipment. The VFD Series will allow 200% torque for a period of time (to overcome intermittent peak loads), then it acts to reduce the output current (or torque) to a preset, safe value which has been set by the TQ Limit trimmer pot. This results in eliminating potential equipment damage by a continuous 200% torque input. The VFD Series includes additional features such as an adjustable carrier frequency of 4-16 kHz, an output frequency range of 0-120 Hz, and an adjustable torque boost for start up. Enable and Direction terminals are included for easy start/stop and direction control.

With its compact size, standard features, and application flexibility, the VFD Series is an excellent choice for most 1 hp and under AC applications.

### VFD Dimensions




VFD01-230VAC, VFD01-D230AC, VFD02-115AC, VFD02-230AC, VFD02-D230AC




VFD04-115AC, VFD04-230AC, VFD04-D230AC

All dimensions in inches [millimeters]

For matching AC motors, see pages 61 to 66.

## FEATURES & BENEFITS

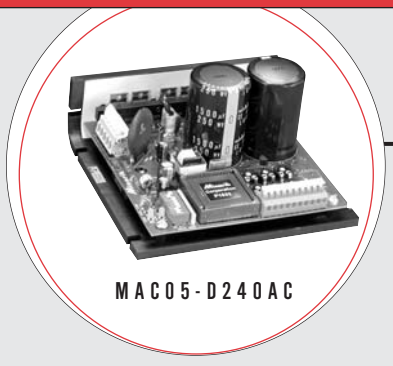
- **AC motors:** Use with 3Ø induction motors as well as 1Ø AC motors such as a permanent split capacitor, shaded pole, AC synchronous and AC stepping.
- **Reversing:** Accomplished via solid-state devices and is as simple as closing a contact.
- **Speed range and regulation:** 2% regulation of base speed. 100:1 speed range.
- **User adjustable calibration pots:** Minimum speed, maximum speed, current limit, acceleration/deceleration, slip compensation and torque boost.
- **Diagnostic LEDs:** Forward, reverse, fault, over current limit trip, current limit, and power.
- **Stopping modes:** Use DC injection braking (N.O.), or coast the motor to a stop (N.C.).
- **Quick connect terminal block:** Quick and easy wire terminations.
- **Carrier frequency:** 11 or 16.5kHz selectable carrier frequency for silent motor operation.
- **Optional isolation:** The HCPL isolation (-PCM option) isolates all inputs and outputs.

### MAC Series Specifications

| Models | Input Voltage (VAC) | Output Voltage (VAC) | HP Rating | Output Current (A) |
|---|---|---|---|---|
| MAC05-D240AC (-PCM) | 115<br>230 | 115/230<br>230 | 1/15-1/4* @ 115VAC or<br>1/6-1/2 @ 230VAC | 2.5 cont.<br>5 peak |
| MAC08-D240AC (-PCM) | 115<br>230 | 115/230<br>230 | 1/4-1/2* @ 115VAC or<br>1/2-1 @ 230VAC | 4 cont.<br>8 peak |

* Horsepower is doubled when voltage doubler terminals are jumpered and using 115 VAC input.

# MAC Series



MAC05-D240AC

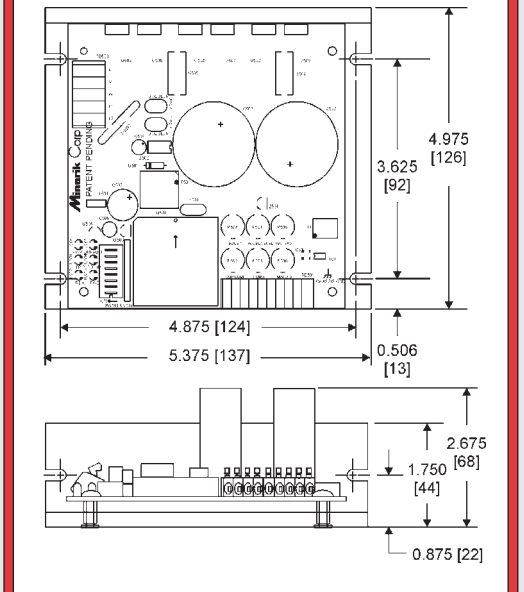
### Typical Applications

- Conveyors
- Pumps
- Hoists & Cranes
- Packaging Machinery
- Industrial and Commercial Machinery

The MAC Series controls most 1Hp or smaller, 115 or 230 VAC three phase AC induction motors, as well as some types of single phase AC motors. The MAC drive is capable of a 100:1 speed range, which means the system speed range will be motor dependent. It will operate with constant torque from 0 to 60 Hz and constant Hp 60-400 Hz. The MAC Series also features solid-state reversing, adjustable acceleration and deceleration, slip compensation, adjustable current limit, and $I^2T$ class 10 current trip to protect the motor, control, and machine. The enable circuit can also be used to interface with the motor's thermal overload for further protection.

Minarik has included even more features to help improve the performance of the AC motor including torque boost during acceleration, adjustable slip compensation, and adjustable minimum and maximum speeds. Up to 8 motors can be controlled by a single MAC drive. All of this is accomplished in a compact 4.98" x 5.38" footprint. For AC induction motors and many single phase motor applications, consider the MAC Series as the first solution.

### MAC Dimensions




For matching AC motors, see pages 61 to 66.

## FEATURES & BENEFITS

- **Isolation:** Inputs and outputs are isolated and allow any speed reference signal to be accepted.
- **Programmable:** Programmed via the front keypad, hand-held EPM programmer, or PC using the Techlink software available on our website www.minarikdrives.com
- **Reversing:** Solid-state devices make reversing as simple as closing a contact.
- **Display:** 3-digit seven segment display for programming, status, and diagnostics.
- **Braking:** DC injection braking is standard with a dynamic braking option available when faster, repetitive stops are needed.
- **Din rail mounting:** An optional din rail mount is available.
- **Carrier frequency:** Adjustable from 4 to 10 kHz to help reduce the audible noise from the motor.
- **Automatic restart:** Can be programmed to automatically restart upon application of power.
- **Skip frequencies:** Two skip frequencies are available to lock out critical frequencies that cause mechanical resonance in the system.
- **48 programmable parameters that include:**

- Four or more ways to start and stop the motor
- DC injection braking time and voltage
- Current limit and motor overload
- Slip compensation
- and many more!
- Two adjustable acceleration & deceleration times (.1 to 3,600 seconds)
- Maximum (240Hz) and minimum (0Hz) frequency
- Fixed and adjustable acceleration boost
- Seven pre-set speeds

# ACM100 Series

### Typical Applications

- Machine Tools
- Conveyors
- Pumps
- Packaging Machinery
- Industrial Washing Machines

ACM100 Series

- **EPM programmer:** Optional hand-held programmer allows you to save thirty (30) programs and download within seconds to the EPM module which plugs into the drive.
- **Default settings:** Drives ship with default settings requiring only a few inputs to be off and running.
- **For use with 3-phase motors**

The ACM100 Series variable frequency, sub-micro, V/Hz drive is a programmable easy to use drive in an IP20 enclosure. It has a 3-digit seven segment display for programming, drive status, and diagnostics. The ACM100 Series has nine isolated inputs and outputs including stop/run, 0-10 VDC input, 4-20mA input, 10 VDC supply for speed pot, DC supply for digital inputs, speed pot common, open collector output, and three programmable inputs.

In addition, the ACM100 Series has several options that include: din rail mount capability, a 1000 Hz output frequency option for very high speed applications, through-hole mounting capability that puts the heat sink outside the drive enclosure for better thermal management, and dynamic braking resistor modules for applications that require quick stops. The ACM100 Series is your best choice when drive control is done from remote locations by process control ( analog references or 0-10 or 4-20mA or simple start/stop.

Part numbers and specifications on page 57.

# 1/4 to 25 Hp
# Isolated PWM AC IP20

## FEATURES & BENEFITS

- **Isolation:** Inputs and outputs are isolated and allow any speed reference signal to be accepted.
- **Programmable:** Programmed using the front keypad, remote keypad, hand-held EPM programmer, Modbus, or through your PC using the Techlink software available on our website ww.minarikcorp.com
- **Reversing:** Solid-state devices make reversing as simple as closing a contact.
- **Display:** 3-digit seven segment display for programming, status and diagnostics.
- **Braking:** DC injection braking is standard with a dynamic braking option available when faster repetitive stops are needed.
- **Din rail mounting:** An optional din rail mount is available.
- **Carrier frequency:** Adjustable from 4 to 10kHz to help reduce the audible noise from the motor.
- **Automatic restart:** Can be programmed to automatically restart upon application of power.
- **Skip frequencies:** Two skip frequencies are available to lock out critical frequencies that cause mechanical resonance in the system.
- **48 programmable parameters that include:**
  - Four or more ways to start and stop the motor
  - DC injection braking time and voltage
  - Current limit and motor overload
  - Slip compensation
  - and many more!
  - Two adjustable acceleration & deceleration times (.1 to 3600 seconds)
  - Maximum (999Hz) and minimum (0Hz) frequency
  - Fixed and adjustable acceleration boost
  - Seven pre-set speeds

# AC200 Series

AC200 Series

## Typical Applications

- Machine Tools
- Conveyors
- Pumps
- Packaging Machinery
- Industrial Washing Machines

- **EPM programmer:** Optional hand-held programmer allows you to save 30 programs and download within seconds to the EPM module which plugs into the drive.
- **For use with 3-phase motors**

The AC200 Series of sub-micro drives are a compact, low-cost solution for AC motor control. The AC200 contains extensive I/O and full programming menu typically found in more expensive drives. This series has a 3-digit seven segment display for programming, drive status, and diagnostics. The AC200 has eighteen isolated inputs and outputs including start, stop, 0-10VDC input, 4-20 mA input, 10VDC supply for external potentiometer, 12 VDC supply for an external relay, two open collector outputs, two analog outputs, three programmable inputs, and RS485 (RXA, RXB).

In addition, the AC200 Series has several options that include: din rail mount capability, a 1000 Hz output frequency option for very high speed applications, through-hole mounting capability that puts the heat sink outside the drive enclosure for better thermal management, and dynamic braking resistor modules for applications that require quick stops. The AC200 Series is a great choice when drive control is done from remote locations by process control (analog references of 0-10 VDC or 4-20mA) or serial communications.

Part number and specifications on page 57.

## ACM100 Series Specifications

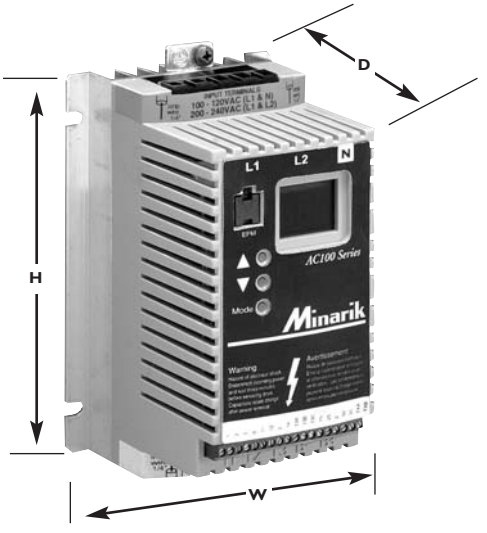
| Models | Input Voltage (VAC) | Input Phase | Output Voltage (VAC) | HP Rating | Output Current (A) | Size* |
|---|---|---|---|---|---|---|
| ACM110S-0.25 | 120 | 1 | 0-200/230 | 1/3 | 1.7 | A5 |
| ACM110S-0.4 | 120 | 1 | 0-200/230 | 1/2 | 2.4 | A5 |
| ACM110S-0.75 | 120 | 1 | 0-200/230 | 1 | 4.2 | B5 |
| ACM110S-1.1 | 120 | 1 | 0-200/230 | 1 1/2 | 6.0 | B5 |
| ACM112S-0.25 | 208/240 | 1 | 0-200/230 | 1/3 | 1.9/1.7 | A5 |
| ACM112S-0.4 | 208/240 | 1 | 0-200/230 | 1/2 | 2.8/2.4 | A5 |
| ACM112S-0.55 | 208/240 | 1 | 0-200/230 | 3/4 | 3.7/3.2 | A6 |
| ACM112S-0.75 | 208/240 | 1 | 0-200/230 | 1 | 4.8/4.2 | A6 |
| ACM112S-1.1 | 208/240 | 1 | 0-200/230 | 1 1/2 | 6.9/6.0 | B5 |
| ACM112S-1.5 | 208/240 | 1 | 0-200/230 | 2 | 8.1/7.0 | B5 |
| ACM112S-2.2 | 208/240 | 1 | 0-200/230 | 3 | 11.0/9.6 | B6 |
| ACM112T-0.4 | 208/240 | 3 | 0-200/230 | 1/2 | 2.8/2.4 | A5 |
| ACM112T-0.75 | 208/240 | 3 | 0-200/230 | 1 | 4.8/4.2 | A6 |
| ACM112T-1.1 | 208/240 | 3 | 0-200/230 | 1 1/2 | 6.9/6.0 | A7 |
| ACM112T-1.5 | 208/240 | 3 | 0-200/230 | 2 | 8.1/7.0 | A7 |
| ACM112T-2.2 | 208/240 | 3 | 0-200/230 | 3 | 11.0/9.6 | B6 |
| ACM112T-3.7 | 208/240 | 3 | 0-200/230 | 5 | 17.5/15.2 | B2 |
| ACM114T-0.4 | 400/480 | 3 | 0-400/460 | 1/2 | 1.3/1.1 | A8 |
| ACM114T-0.75 | 400/480 | 3 | 0-400/460 | 1 | 2.5/2.1 | A9 |
| ACM114T-1.1 | 400/480 | 3 | 0-400/460 | 1 1/2 | 3.6/3.0 | A10 |
| ACM114T-1.5 | 400/480 | 3 | 0-400/460 | 2 | 4.1/3.4 | A10 |
| ACM114T-2.2 | 400/480 | 3 | 0-400/460 | 3 | 5.8/4.8 | B1 |
| ACM114T-3.7 | 400/480 | 3 | 0-400/460 | 5 | 9.4/7.8 | B2 |

## AC200 Series Specifications

| Models | Input Voltage (VAC) | Input Phase | Output Voltage (VAC) | HP Rating | Output Current (A) | Size* |
|---|---|---|---|---|---|---|
| AC211S-0.75 | 120/208/240 | 1 | 0-230/200/230 | 1 | 4.0/4.6/4.0 | B1 |
| AC211S-1.1 | 120/208/240 | 1 | 0-230/200/230 | 1.5 | 5.4/6.2/5.4 | B1 |
| AC212B-0.2 | 208/240 | 1/3 | 0-200/230 | 1/4 | 1.6/1.4 | A8 |
| AC212B-0.4 | 208/240 | 1/3 | 0-200/230 | 1/2 | 2.5/2.2 | A8 |
| AC212B-0.75 | 208/240 | 1/3 | 0-200/230 | 1 | 4.6/4.0 | A9 |
| AC212B-1.1 | 208/240 | 1/3 | 0-200/230 | 1.5 | 6.2/4.4 | B1 |
| AC212B-1.5 | 208/240 | 1/3 | 0-200/230 | 2 | 7.8/6.8 | B2 |
| AC212B-2.2 | 208/240 | 1/3 | 0-200/230 | 3 | 11.0/9.6 | B2 |
| AC212B-3.7 | 208/240 | 1/3 | 0-200/230 | 5 | 17.5/15.2 | C1 |
| AC212T-0.75 | 208/240 | 3 | 0-200/230 | 1 | 4.6/4.0 | A9 |
| AC212T-1.1 | 208/240 | 3 | 0-200/230 | 1.5 | 6.2/4.4 | A10 |
| AC212T-1.5 | 208/240 | 3 | 0-200/230 | 2 | 7.8/6.8 | A10 |
| AC212T-2.2 | 208/240 | 3 | 0-200/230 | 3 | 11.0/9.8 | A10 |
| AC212T-3.7 | 208/240 | 3 | 0-200/230 | 5 | 17.5/15.2 | B2 |
| AC212T-5.5 | 208/240 | 3 | 0-200/230 | 7.5 | 25.3/22.0 | C1 |
| AC212T-7.5 | 208/240 | 3 | 0-200/230 | 10 | 30.0/28.0 | C1 |
| AC212T-11 | 208/240 | 3 | 0-200/230 | 15 | 48/42 | D1 |
| AC212T-15 | 208/240 | 3 | 0-200/230 | 20 | 58/54 | D1 |
| AC214T-0.4 | 400/480 | 3 | 0-400/460 | 1/2 | 1.3/1.1 | A8 |
| AC214T-0.75 | 400/480 | 3 | 0-400/460 | 1 | 2.3/2.0 | A9 |
| AC214T-1.1 | 400/480 | 3 | 0-400/460 | 1.5 | 3.1/2.7 | A10 |
| AC214T-1.5 | 400/480 | 3 | 0-400/460 | 2 | 3.9/3.4 | A10 |
| AC214T-2.2 | 400/480 | 3 | 0-400/460 | 3 | 5.5/4.8 | A10 |
| AC214T-3.7 | 400/480 | 3 | 0-400/460 | 5 | 8.7/7.6 | B2 |
| AC214T-5.5 | 400/480 | 3 | 0-400/460 | 7.5 | 12.6/11.0 | C1 |
| AC214T-7.5 | 400/480 | 3 | 0-400/460 | 10 | 16.1/14.0 | C1 |
| AC214T-11 | 400/480 | 3 | 0-400/460 | 15 | 24/21 | D1 |
| AC214T-15 | 400/480 | 3 | 0-400/460 | 20 | 31/27 | D1 |
| AC214T-18.5 | 400/480 | 3 | 0-400/460 | 25 | 39/34 | D1 |
| AC215T-0.75 | 480/590 | 3 | 0-460/575 | 1 | 1.8/1.6 | A9 |
| AC215T-1.5 | 480/590 | 3 | 0-460/575 | 2 | 3.4/3.0 | A10 |
| AC215T-2.2 | 480/590 | 3 | 0-460/575 | 3 | 4.2/4.2 | B2 |
| AC215T-3.7 | 480/590 | 3 | 0-460/575 | 5 | 6.6/6.6 | B2 |
| AC215T-5.5 | 480/590 | 3 | 0-460/575 | 7.5 | 9.6/9.6 | C1 |
| AC215T-7.5 | 480/590 | 3 | 0-460/575 | 10 | 12.2/12.2 | C1 |
| AC215T-11 | 480/590 | 3 | 0-460/575 | 15 | 19/19 | D1 |
| AC215T-15 | 480/590 | 3 | 0-460/575 | 20 | 24/24 | D1 |
| AC215T-18.5 | 480/590 | 3 | 0-460/575 | 25 | 27/27 | D1 |

*For dimensional details see page 58.

## ACM100 & AC200 Dimensions




| Size | Height | Width | Depth |
|---|---|---|---|
| A1 | 5.75 (146) | 2.88 (73) | 3.76 (96) |
| A2 | 5.75 (146) | 2.88 (73) | 4.56 (116) |
| A3 | 5.75 (146) | 2.88 (73) | 5.56 (141) |
| A5 | 5.75 (146) | 2.88 (73) | 3.26 (83) |
| A6 | 5.75 (146) | 2.88 (73) | 3.63 (92) |
| A7 | 5.75 (146) | 2.88 (73) | 5.56 (141) |
| A8 | 5.75 (146) | 2.88 (73) | 3.94 (100) |
| A9 | 5.75 (146) | 2.88 (73) | 4.74 (120) |
| A10 | 5.75 (146) | 2.88 (73) | 5.74 (146) |
| B1 | 5.75 (146) | 3.76 (96) | 5.24 (133) |
| B2 | 5.75 (146) | 3.76 (96) | 6.74 (171) |
| B5 | 5.75 (146) | 3.76 (96) | 4.88 (124) |
| B6 | 5.75 (146) | 3.76 (96) | 5.53 (140) |
| C1 | 7.75 (197) | 5.02 (128) | 7.18 (182) |
| D1 | 9.75 (273) | 6.68 (170) | 8 (203) |

## FEATURES & BENEFITS

- **Programmable:** Can be programmed using the front keypad, remote keypad, Modbus, or through your PC using the Techlink software available on our website www.minarikdrives.com
- **Reversing:** Solid-state devices make reversing as simple as closing a contact.
- **Display:** 16 character backlit LCD display for programming, status, and diagnostics.
- **Braking:** DC injection braking is standard with a dynamic braking option when faster and repetitive stops are needed.
- **Carrier frequency:** Adjustable from 2.5 to 14kHz to help reduce the audible noise from the motor.
- **Automatic restart:** Can be programmed to automatically restart upon application of power.
- **Skip frequencies:** Two skip frequencies are available to lock out critical frequencies that cause mechanical resonance in the system.
- **Isolation:** Inputs and outputs are isolated and allow any speed reference signal to be accepted.
- **PID setpoint control:** Closed loop control to automatically maintain set point based on process control feedback (AC400 only).
- **NEMA enclosure choices:** Choose either NEMA1, 4/12 or 4X (see page 60).

# AC300 & AC400 Series

The AC300 and AC400 Series variable frequency, micro, V/Hz drive offers the widest range of voltages, power ratings, and enclosure types. These drives meet the toughest requirements from harsh environments to high torque loads. They are housed in a heavy-duty steel enclosure for solid mechanical protection and electrical shielding. The AC300 and the AC400 Series have many of the same features except the AC400 has a built-in PID control feature which allows for closed-loop control to automatically adjust the motor speed to maintain the set point.

The AC300 and AC400 have a 16 character backlit display for programming, drive status, and diagnostics. They have 21 isolated inputs and outputs including start, stop, 0-10VDC input, 4-20mA input, 10VDC supply for an external potentiometer, 12VDC supply for an external relay, two open collector outputs, two analog outputs, three programmable inputs, two relay outputs, and RS485 (RXA, TXB).

### Typical Applications

- Machine Tools
- Positioning
- Conveyors
- HVAC Systems
- Packaging Machinery
- Industrial Washing Machines

AC300 Series

The AC300 and AC400 have over 55 programmable parameters that include: 4 or more ways to start and stop the motor, forward and/or reverse rotation, two adjustable acceleration and deceleration times (0.1 to 3600 seconds), DC injection braking time and voltage, maximum (120 Hz) and minimum frequency (0 Hz), current limit, motor overload, fixed and acceleration boost, slip compensation, 4 preset speeds, skip frequencies, and many more. These units can be programmed using the eight button keypad on the front of the drive enclosure, a remote keypad, a "point and click" Windows software (Techlink) that runs on a PC and works through the RS485, or with Modbus. The drives are shipped with default settings which shorten the time for setup requiring only a few adjustments in the program before the application can be off and running.

OPTIONS: In addition to the many standard features these units have they also have an optional dynamic brake card and resistor for those applications requiring quick repetitive stops, a second Form C auxiliary relay in an option card, and a rugged NEMA 4 keypad mounting kit.

The AC300 and AC400 Series are full-featured, rugged, and compact micro drives priced to fit your budget. Choose the AC300 or AC400 for your next AC, V/Hz drive application.

Part numbers and specifications on page 60.

## AC300& AC400 Series Ratings & Dimensions

| Hp | Input Voltage | Input Phase | Output Amps | NEMA1 Model | H x W x D (inches) | NEMA 4 & 12 Model | NEMA 4X Model | H x W x D (inches) |
|---|---|---|---|---|---|---|---|---|
| 1/4 (.20kW) | 240/120 | 1Ø | 1.4 | AC(*)21S-0.2 | 7.50 x 4.70 x 3.33 | AC(*)31S-0.2 | AC351S-0.2 | 7.88 x 6.12 x 3.63 |
| 1/2 (.4kW) | 240/120<br>240<br>240/200 | 1Ø<br>1Ø<br>3Ø | 2.2<br>2.2<br>2.2/2.5 | AC(*)21S-0.4<br>AC(*)22S-0.4<br>AC(*)22T-0.4 | 7.50 x 6.12 x 3.63<br>7.50 x 4.70 x 3.63<br>7.50 x 4.70 x 3.63 | AC(*)31S-0.4<br>AC(*)32S-0.4<br>AC(*)32T-0.4 | AC351S-0.4<br>AC352S-0.4<br>AC352T-0.4 | 7.88 x 7.86 x 3.75<br>7.88 x 6.12 x 4.35<br>7.88 x 6.12 x 4.35 |
| 1 (.75kW) | 240/120<br>240<br>240/200<br>480/400<br>590 | 1Ø<br>1Ø<br>3Ø<br>3Ø<br>3Ø | 4.0<br>4.0<br>4.0/4.6<br>2.0/2.3<br>1.6 | AC(*)21S-0.75<br>AC(*)22S-0.75<br>AC(*)22T-0.75<br>AC(*)24T-0.75<br>AC(*)25T-0.75 | 7.50 x 6.12 x 4.22<br>7.50 x 4.70 x 4.33<br>7.50 x 4.70 x 4.33<br>7.50 x 4.70 x 3.63<br>7.50 x 4.70 x 3.63 | AC(*)31S-0.75<br>AC(*)32S-0.75<br>AC(*)32T-0.75<br>AC(*)34T-0.75<br>AC(*)35T-0.75 | AC351S-0.75<br>AC352S-0.75<br>AC352T-0.75<br>AC354T-0.75<br>AC355T-0.75 | 7.88 x 7.86 x 4.90<br>7.88 x 6.12 x 4.35<br>7.88 x 6.12 x 4.35<br>7.88 x 6.12 x 4.35<br>7.88 x 6.12 x 4.35 |
| 1.5 (1.1kW) | 240/120<br>240<br>240/200 | 1Ø<br>1Ø<br>3Ø | 5.2<br>5.2<br>5.2/6.0 | AC(*)21S-1.1<br>AC(*)22S-1.1<br>AC(*)22T-1.1 | 7.50 x 6.12 x 4.22<br>7.50 x 6.12 x 4.22<br>7.50 x 4.70 x 4.33 | AC(*)31S-1.1<br>AC(*)32S-1.1<br>AC(*)32T-1.1 | AC351S-1.1<br>AC352S-1.1<br>AC352T-1.1 | 7.88 x 7.86 x 4.90<br>7.88 x 7.86 x 4.90<br>7.88 x 6.12 x 5.25 |
| 2 (1.5kW) | 240<br>240/200<br>480/400<br>590 | 1Ø<br>3Ø<br>3Ø<br>3Ø | 6.8<br>6.8/7.8<br>3.4/3.9<br>2.7 | AC(*)22S-1.5<br>AC(*)22T-1.5<br>AC(*)24T-1.5<br>AC(*)25T-1.5 | 7.50 x 6.12 x 5.12<br>7.50 x 6.12 x 5.12<br>7.50 x 6.12 x 4.22<br>7.50 x 6.12 x 4.22 | AC(*)32S-1.5<br>AC(*)32T-1.5<br>AC(*)34T-1.5<br>AC(*)35T-1.5 | AC352S-1.5<br>AC352T-1.5<br>AC354T-1.5<br>AC355T-1.5 | 7.88 x 7.86 x 4.90<br>7.88 x 7.86 x 4.90<br>7.88 x 7.86 x 4.90<br>7.88 x 7.86 x 4.90 |
| 3 (2.2kW) | 240<br>240/200<br>480/400<br>590 | 1Ø<br>3Ø<br>3Ø<br>3Ø | 9.6<br>9.6/11.0<br>4.8/5.5<br>3.9 | AC(*)22S-2.2<br>AC(*)22T-2.2<br>AC(*)24T-2.2<br>AC(*)25T-2.2 | 7.50 x 6.12 x 5.12<br>7.50 x 6.12 x 5.12<br>7.50 x 6.12 x 5.12<br>7.50 x 6.12 x 5.12 | AC(*)32S-2.2<br>AC(*)32T-2.2<br>AC(*)34T-2.2<br>AC(*)35T-2.2 | AC352S-2.2<br>AC352T-2.2<br>AC354T-2.2<br>AC355T-2.2 | 7.88 x 7.86 x 5.90<br>7.88 x 7.86 x 5.90<br>7.88 x 7.86 x 4.90<br>7.88 x 7.86 x 4.90 |
| 5 (3.7kW) | 240/200<br>480/400<br>590 | 3Ø<br>3Ø<br>3Ø | 15.2/17.5<br>7.6/8.7<br>6.1 | AC(*)22T-3.7<br>AC(*)24T-3.7<br>AC(*)25T-3.7 | 7.88 x 7.86 x 5.94<br>7.50 x 6.12 x 5.12<br>7.50 x 7.86 x 5.94 | AC(*)32T-3.7<br>AC(*)34T-3.7<br>AC(*)35T-3.7 | AC352T-3.7<br>AC354T-3.7<br>AC355T-3.7 | 9.75 x 10.26 x 7.20<br>7.88 x 7.86 x 5.90<br>7.88 x 7.86 x 5.90 |
| 7.5 (5.5kW) | 240/200<br>480/400<br>590 | 3Ø<br>3Ø<br>3Ø | 22/25<br>11/12.6<br>9 | AC(*)22T-5.5<br>AC(*)24T-5.5<br>AC(*)25T-5.5 | 9.38 x 7.86 x 6.84<br>9.38 x 7.86 x 6.25<br>9.38 x 7.86 x 6.25 | AC(*)32T-5.5<br>AC(*)34T-5.5<br>AC(*)35T-5.5 | AC352T-5.5<br>AC354T-5.5<br>AC355T-5.5 | 11.75 x 10.26 x 8.35<br>9.75 x 10.26 x 7.20<br>9.75 x 10.26 x 7.20 |
| 10 (7.5kW) | 240/200<br>480/400<br>590 | 3Ø<br>3Ø<br>3Ø | 28/32<br>14/16<br>11 | AC(*)22T-7.5<br>AC(*)24T-7.5<br>AC(*)25T-7.5 | 11.25 x 7.86 x 6.84<br>9.38 x 7.86 x 6.84<br>9.38 x 7.86 x 7.40 | AC(*)32T-7.5<br>AC(*)34T-7.5<br>AC(*)35T-7.5 | AC352T-7.5<br>AC354T-7.5<br>AC355T-7.5 | 13.75 x 10.26 x 8.35<br>11.75 x 10.26 x 8.35<br>11.75 x 10.26 x 8.35 |
| 15 (11kW) | 240/200<br>480/400<br>590 | 3Ø<br>3Ø<br>3Ø | 42/48<br>21/24<br>17 | AC(*)22T-11<br>AC(*)24T-11<br>AC(*)25T-11 | 12.75 x 7.86 x 6.84<br>11.25 x 7.86 x 6.84<br>12.75 x 7.86 x 6.84 | AC(*)32T-11<br>AC(*)34T-11<br>AC(*)35T-11 | AC352T-11<br>AC354T-11<br>AC355T-11 | 15.75 x 10.26 x 8.35<br>13.75 x 10.26 x 8.35<br>13.75 x 10.26 x 8.35 |
| 20 (15kW) | 240/200<br>480/400<br>590 | 3Ø<br>3Ø<br>3Ø | 54/62<br>27/31<br>22 | AC(*)22T-15<br>AC(*)24T-15<br>AC(*)25T-15 | 12.75 x 10.26 x 7.74<br>12.75 x 7.86 x 6.84<br>12.75 x 7.86 x 7.40 | AC(*)42T-15<br>AC(*)34T-15<br>AC(*)35T-15 | ----------<br>AC354T-15<br>AC355T-15 | 15.75 x 10.26 x 8.35<br>15.75 x 10.26 x 8.35<br>15.75 x 10.26 x 8.35 |
| 25 (18.5kW) | 240/200<br>480/400<br>590 | 3Ø<br>3Ø<br>3Ø | 68/78<br>34/39<br>27 | AC(*)22T-18.5<br>AC(*)24T-18.5<br>AC(*)25T-18.5 | 15.75 x 10.26 x 8.35<br>12.75 x 10.26 x 7.74<br>12.75 x 10.26 x 7.74 | ----------<br>AC(*)44T-18.5<br>AC(*)45T-18.5 | ----------<br>----------<br>---------- | -----  -----  -----<br>15.75 x 10.26 x 8.35<br>15.75 x 10.26 x 8.35 |
| 30 (22kW) | 240/200<br>480/400<br>590 | 3Ø<br>3Ø<br>3Ø | 80/92<br>40/46<br>32 | AC(*)22T-22<br>AC(*)24T-22<br>AC(*)25T-22 | 15.75 x 10.26 x 8.35<br>12.75 x 10.26 x 7.74<br>12.75 x 10.26 x 8.25 | ----------<br>AC(*)44T-22<br>AC(*)45T-22 | ----------<br>----------<br>---------- | -----  -----  -----<br>15.75 x 10.26 x 8.35<br>15.75 x 10.26 x 8.35 |
| 40 (30kW) | 480/400<br>590 | 3Ø<br>3Ø | 52/60<br>41 | AC(*)24T-30<br>AC(*)25T-30 | 15.75 x 10.26 x 8.35<br>15.75 x 10.26 x 8.35 | ----------<br>---------- | ----------<br>---------- | ----------<br>---------- |
| 50 (37kW) | 480/400<br>590 | 3Ø<br>3Ø | 65/75<br>52 | AC(*)24T-37<br>AC(*)25T-37 | 19.75 x 10.26 x 8.55<br>19.75 x 10.26 x 8.55 | ----------<br>---------- | ----------<br>---------- | ----------<br>---------- |
| 60 (45kW) | 480/400<br>590 | 3Ø<br>3Ø | 77/80<br>62 | AC(*)24T-45<br>AC(*)25T-45 | 19.75 x 10.26 x 8.55<br>19.75 x 10.26 x 8.55 | ----------<br>---------- | ----------<br>---------- | ----------<br>---------- |

Note 1: (*) 3 = AC300 Series  4 = AC400 Series
Note 2: Model numbers with a "3" as a second digit (AC(*)3) are suitable for NEMA 4 and NEMA 12 applications
Note 3: Model numbers with a "4" as a second digit (AC(*)4) are suitable for NEMA 12 applications

Add "P" suffix for remote keyboard (This option can be combined with only one (1) of the three (3) options listed below when ordering).
Add "H" suffix for an additional Form C relay board.
Add "J" suffix for a dynamic braking board (for units 5 Hp and below only). Brake resistors are purchased separately
Add "K" suffix for a dynamic braking and Form C relay board (for units above 5 Hp only). Brake resistors are purchased separately.

## FEATURES & BENEFITS

- Geared versions have rugged aluminum die cast housings.
- Precision machined gearing, hardened for maximum load capacities.
- Oversized bearings for overhung load capacity and longer life.
- High-carbon alloy output shaft.
- Double-lip, heavy-duty industrial oil seals.
- 1/2 Hp units wound for either 115 or 230 VAC 3-phase input.
- All units compatible with Minarik's variable frequency AC motor drives (VFD, VFD-PCM, MAC & AC Series).

# Motor Performance Data

### Delta-Wave Series

| Motor Part Number | Motor Power [Hp] | Shaft Speed @ FL [RPM] | Continuous Torque [in-lbs] | Speed Reduction [ratio:1] | Input Voltage 3 ph [VAC] | Rated Current (cont.) [Amps] | Test Frequency [Hz] | Frame & Style |
|---|---|---|---|---|---|---|---|---|
| 506-20-001 | 1/15 | 1700 | 2.5 | None | 115 | 1.10 | 60 | 31 Frame TENV |
| 506-22-001 | 1/15 | 1700 | 2.5 | None | 230 | 0.54 | 60 | 31 Frame TENV |
| 506-21-004 | 1/15 | 150 | 25 | 11.5 | 115 | 0.78 | 60 | 38 Frame TENV |
| 506-23-004 | 1/15 | 150 | 25 | 11.5 | 230 | 0.39 | 60 | 38 Frame TENV |
| 506-21-001 | 1/15 | 140 | 28 | 12 | 115 | 1.10 | 60 | 31 Frame TENV |
| 506-23-001 | 1/15 | 140 | 28 | 12 | 230 | 0.54 | 60 | 31 Frame TENV |
| 506-21-005 | 1/15 | 75 | 52 | 23 | 115 | 0.78 | 60 | 38 Frame TENV |
| 506-23-005 | 1/15 | 75 | 52 | 23 | 230 | 0.39 | 60 | 38 Frame TENV |
| 506-21-002 | 1/15 | 57 | 67 | 30 | 115 | 1.10 | 60 | 31 Frame TENV |
| 506-23-002 | 1/15 | 57 | 67 | 30 | 230 | 0.54 | 60 | 31 Frame TENV |
| 506-23-006 | 1/15 | 33 | 110 | 52 | 230 | 0.39 | 60 | 38 Frame TENV |
| 506-21-006 | 1/15 | 33 | 110 | 52 | 115 | 0.78 | 60 | 38 Frame TENV |
| 506-21-003 | 1/15 | 28 | 100 | 60 | 115 | 1.10 | 60 | 31 Frame TENV |
| 506-23-003 | 1/15 | 28 | 100 | 60 | 230 | 0.54 | 60 | 31 Frame TENV |
| 506-20-002 | 1/6 | 1725 | 6 | None | 115 | 1.50 | 60 | 38 Frame TENV |
| 506-22-002 | 1/6 | 1725 | 6 | None | 230 | 0.72 | 60 | 38 Frame TENV |
| 506-21-007 | 1/6 | 163 | 60 | 10.6 | 115 | 1.50 | 60 | 38 Frame TENV |
| 506-23-007 | 1/6 | 163 | 60 | 10.6 | 230 | 0.72 | 60 | 38 Frame TENV |
| 506-21-008 | 1/6 | 60 | 160 | 29 | 115 | 1.50 | 60 | 38 Frame TENV |
| 506-23-008 | 1/6 | 60 | 160 | 29 | 230 | 0.72 | 60 | 38 Frame TENV |
| 506-21-009 | 1/6 | 30 | 324 | 58 | 115 | 1.50 | 60 | 38 Frame TENV |
| 506-23-009 | 1/6 | 30 | 324 | 58 | 230 | 0.72 | 60 | 38 Frame TENV |
| 506-24-001 | 1/2 | 1725 | 18 | None | 115/230 | 4.0/2.0 | 60 | 48 Frame TEFC |
| 506-25-001 | 1/2 | 133 | 229 | 12.7 | 115/230 | 4.0/2.0 | 60 | 48 Frame TEFC |
| 506-25-002 | 1/2 | 41 | 700 | 42 | 115/230 | 4.0/2.0 | 60 | 48 Frame TEFC |

Optional conduit box and gearmotor mounting bracket shown on page 95.

# 1/15th Hp 115VAC or 230VAC TENV
## AC 3-phase Motors

### Z SERIES
### FEATURES & BENEFITS

- 3-phase Induction Motor
- 1/15th Hp
- Compatible with Minarik's VFD, VFD-PCM, MAC & AC Series drives
- Totally enclosed non-ventilated (TENV)
- Geared and non-geared versions
- Non-geared versions come with foot mount

### Specifications
**TENV • 115 or 230v • Three Phase • 1.0 Service Factor**

| Model Number | Input Voltage (VAC) | Ratio to 1 | Input HP | Output RPM | F.L. Torque (In.-Lb.) | F.L. Amps VAC | Over-hung Load (Lb.) | P | DIMENSIONS X | DIMENSIONS XL | XH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Inches | | |
| 506-21-001 | 115 | 12 | 1/15 | 140 | 28 | 1.10 | 180 | 3.07 | 2.14 | 9.16 | 7.96 |
| 506-21-002 | 115 | 30 | 1/15 | 57 | 67 | 1.10 | 171 | 3.07 | 2.43 | 9.16 | 7.96 |
| 506-21-003 | 115 | 60 | 1/15 | 28 | 100 | 1.10 | 155 | 3.07 | 2.43 | 9.16 | 7.96 |
| 506-23-001 | 230 | 12 | 1/15 | 140 | 28 | 0.54 | 180 | 3.07 | 2.14 | 8.87 | 7.67 |
| 506-23-002 | 230 | 30 | 1/15 | 57 | 67 | 0.54 | 171 | 3.07 | 2.43 | 9.16 | 7.96 |
| 506-23-003 | 230 | 60 | 1/15 | 28 | 100 | 0.54 | 155 | 3.07 | 2.43 | 9.16 | 7.96 |

# Delta-Wave Series

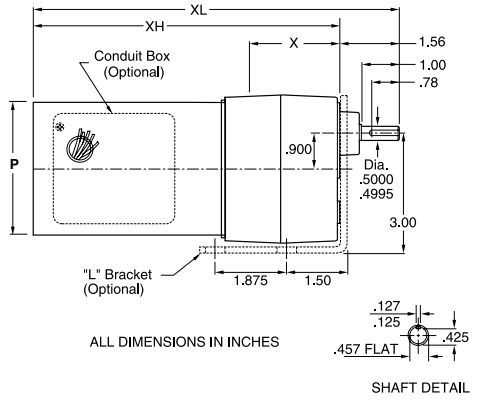
Finally, there is a convenient and simple AC 3-phase motor that can be controlled with a variable frequency drive. Minarik's VFD, VFD-PCM, MAC & AC Series drives take a single phase 115 VAC or 230 VAC input, and outputs 115 VAC or 230 VAC respectively in three phases to power these motors. Earlier technology and costs prevented 115 VAC 3-phase motor growth, but now Minarik offers either the 115 or the 230 VAC system packages as a powerful, efficient, cost-effective solution to your motion control needs.

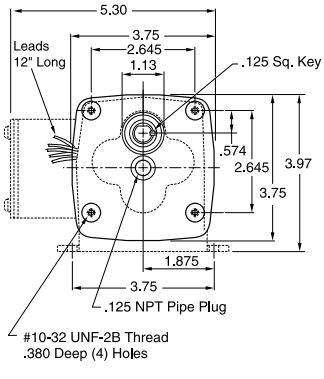
The compact 31 frame motor features class F2 insulation and is rated for continuous duty. It is available with or without a gearhead to achieve the proper torque and speed you desire. Gearhead versions are available in 12, 30, and 60 to 1 ratios. They feature precision machined gearing which is hardened for maximum load capabilities. Geared models have oversized output bearings for greater overhung load capacity and longer life. High carbon output shafts provide maximum strength and rigidity. All needle bearing journals are precision ground after heat treating, to provide maximum finish and fit. The gearmotors are designed for mounting at any angle, however, vertical mounting with the shaft up with motor below is not recommended.

See compatibility chart on page 66 for recommended AC drives.

Optional conduit box and mounting bracket on page 95.

### Dimensions



## D SERIES
## FEATURES & BENEFITS

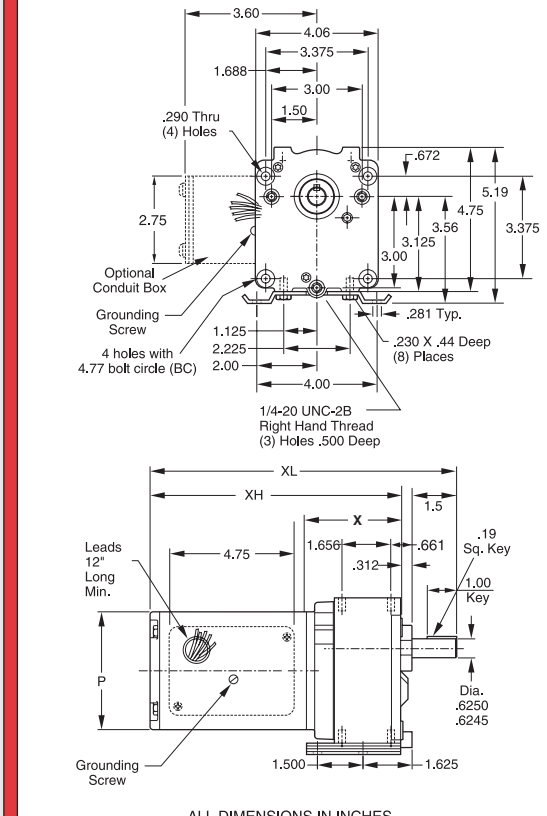
- 3-phase Induction Motor
- 1/15th Hp
- Compatible with Minarik's VFD, VFD-PCM,MAC & AC Series drives
- Totally enclosed non-ventilated (TENV)
- Hardened spur gearhead models
- Non-Geared versions come with footmount

### Specifications
### TENV • 115 or 230v • Three Phase • 1.0 Service Factor

| Model Number | Input Voltage (VAC) | Ratio to 1 | Input HP | Output RPM | F.L. Torque (In.-Lb.) | F.L. Amps VAC | Over-hung Load (Lb.) | DIMENSIONS P | X | XL | XH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Inches | | | |
| 506-21-004 | 115 | 11.5 | 1/15 | 150 | 25 | 0.78 | 208 | 3.86 | 3.50 | 9.96 | 8.46 |
| 506-21-005 | 115 | 23 | 1/15 | 75 | 52 | 0.78 | 256 | 3.86 | 3.50 | 9.96 | 8.46 |
| 506-21-006 | 115 | 52 | 1/15 | 33 | 110 | 0.78 | 330 | 3.86 | 3.50 | 9.96 | 8.46 |
| 506-23-004 | 230 | 11.5 | 1/15 | 150 | 25 | 0.39 | 208 | 3.86 | 3.50 | 9.96 | 8.46 |
| 506-23-005 | 230 | 23 | 1/15 | 75 | 52 | 0.39 | 256 | 3.86 | 3.50 | 9.96 | 8.46 |
| 506-23-006 | 230 | 52 | 1/15 | 33 | 110 | 0.39 | 330 | 3.86 | 3.50 | 9.96 | 8.46 |

# Delta-Wave Series

### Dimensions




ALL DIMENSIONS IN INCHES

Finally, there is a convenient and simple AC 3-phase motor that can be controlled with a variable frequency drive. Minarik's VFD, VFD-PCM, MAC & AC Series drives take a single phase 115 VAC or 230 VAC input, and outputs 115 VAC or 230 VAC respectively, in three phases to power these motors. Earlier technology and costs prevented 115 VAC, 3-phase motor growth, but now Minarik offers either the 115 or the 230 VAC system packaged as a powerful, efficient, cost effective solution to your motion control needs.

The 38 frame motor features class F2 insulation and is rated for continuous duty. It is available with a gearhead to achieve the proper torque and speed you desire. These gearmotors provide ratios of 11.5, 23 and 52 to 1. They feature precision machined gearing which is hardened for maximum load capabilities. Geared models have oversized output bearings for greater overhung load capacity and longer life. High carbon output shafts provide maximum strength and rigidity. All needle bearing journals are precision ground after heat treating to provide maximum finish and fit. The gearmotors are designed for mounting at any angle, but shaft up with motor below is not recommended. Conduit box available upon request.

See compatibility chart on page 66 for recommended AC drives.

Optional conduit box and mounting bracket on page 95.

# 1/6th Hp TENV
## AC 3-phase Motors

**D SERIES**

**FEATURES & BENEFITS**

- 3-phase Induction Motor
- 1/6th Hp
- Compatible with Minarik's VFD, VFD-PCM, MAC & AC Series drives
- Totally enclosed non-ventilated (TENV)
- Geared and non-geared versions
- Non-geared version comes with footmount

**Specifications**
**TENV • 115 or 230v • Three Phase • 1.0 Service Factor**

| Model Number | Input Voltage (VAC) | Ratio to 1 | Input HP | Output RPM | F.L. Torque (In.-Lb.) | F.L. Amps VAC | Over-hung Load (Lb.) | DIMENSIONS P | X | XL | XH |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Inches | | | |
| 506-21-007 | 115 | 10.6 | 1/6 | 163 | 60 | 1.50 | 201 | 3.86 | 3.50 | 10.96 | 9.46 |
| 506-21-008 | 115 | 29 | 1/6 | 60 | 160 | 1.50 | 268 | 3.86 | 3.50 | 10.96 | 9.46 |
| 506-21-009 | 115 | 58 | 1/6 | 30 | 324 | 1.50 | 330 | 3.86 | 3.50 | 10.96 | 9.46 |
| 506-23-007 | 230 | 10.6 | 1/6 | 163 | 60 | 0.72 | 201 | 3.86 | 3.50 | 10.96 | 9.46 |
| 506-23-008 | 230 | 29 | 1/6 | 60 | 160 | 0.72 | 268 | 3.86 | 3.50 | 10.96 | 9.46 |
| 506-23-009 | 230 | 58 | 1/6 | 30 | 324 | 0.72 | 330 | 3.86 | 3.50 | 10.96 | 9.46 |

# Delta Wave Series

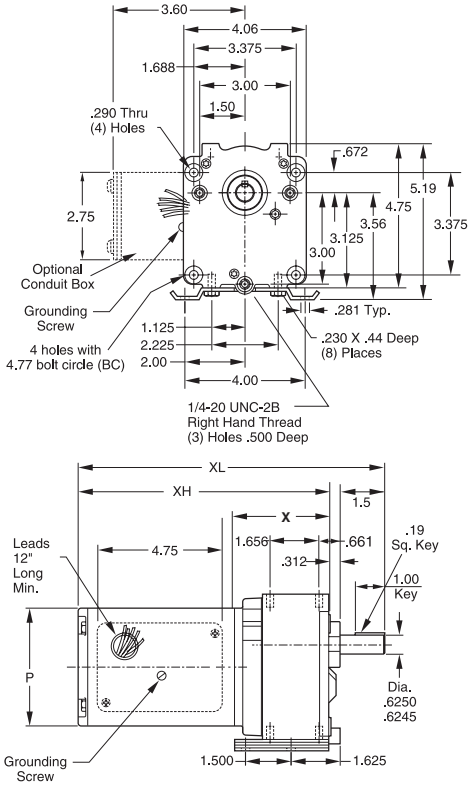
Finally, there is a convenient and simple AC 3-phase motor that can be controlled with a variable frequency drive. Minarik's VFD, VFD-PCM, MAC & AC Series drives take a single phase 115 VAC or 230 VAC input, and outputs 115 VAC or 230 VAC respectively, in three phases to power these motors. Earlier technology and costs prevented 115 VAC 3-phase motor growth, but now Minarik offers either the 115 or the 230 VAC system packages as a powerful, efficient, cost-effective solution to your motion control needs.

The compact 38 frame motor features class F2 insulation and is rated for continuous duty. It is available with or without a gearhead to achieve the proper torque and speed you desire. Gearbox versions are available in 10.6, 29, and 58 to 1 ratios. They feature precision machined gearing which is hardened for maximum load capabilities. Geared models have oversized output bearings for greater overhung load capacity and longer life. High carbon output shafts provide maximum strength and rigidity. All needle bearing journals are precision ground after heat treating, to provide maximum finish and fit. The gearmotors are designed for mounting at any angle, but shaft up with motor below is not recommended.

See compatibility chart on page 66 for recommended AC drives.

Optional conduit box and mounting bracket on page 95.

**Dimensions**




ALL DIMENSIONS IN INCHES

## F SERIES
## FEATURES & BENEFITS

- 3-phase Induction Motor
- Dual voltage windings for either 115 VAC or 230 VAC use
- 1/2 Hp
- Compatible with Minarik's VFD, VFD-PCM, MAC & AC drives
- Totally enclosed fan cooled (TEFC)
- Footmount and conduit box standard

### Specifications
### TEFC • Three Phase • Fractional HP • 115/230V

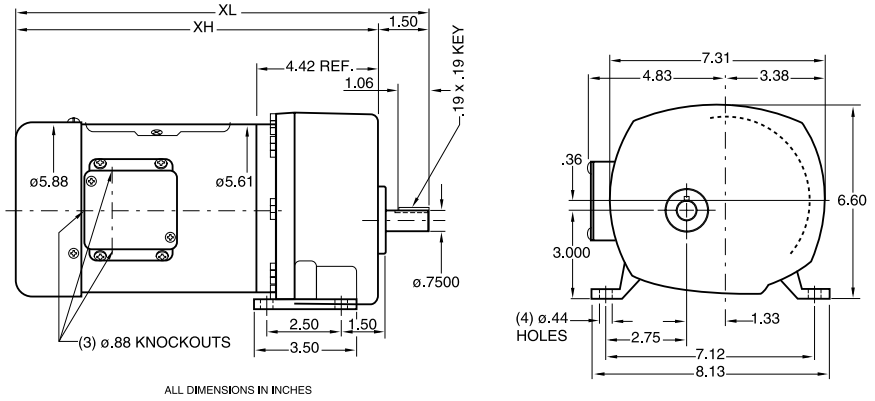
| Model Number | Ratio to 1 | Input HP | Output RPM | F.L. Torque (In.-Lb.) | F.L. Amps 115VAC | Over-hung Load (Lb.) | DIMENSIONS XL Inches | DIMENSIONS XH Inches |
|---|---|---|---|---|---|---|---|---|
| 506-25-001 | 13 | 1/2 | 133 | 229 | 2.0 | 500 | 13.80 | 12.30 |
| 506-25-002 | 42 | 1/2 | 41 | 700 | 2.0 | 650 | 13.80 | 12.30 |

# Delta Wave Series

Finally, there is a convenient and simple AC 3-phase motor that can be controlled with a variable frequency drive. Minarik's VFD, VFD-PCM, MAC and AC drives take a single phase 115 VAC or 230 VAC input, and outputs 115 VAC or 230 VAC respectively, in three phases to power these motors. Earlier technology and costs prevented 115 VAC, 3-phase motor growth, but now Minarik offers either the 115 or the 230 VAC system packaged as a powerful, efficient solution to your motion control needs.

This 48 frame motor has dual voltage windings that can be powered by either 115 VAC 3 phase input or 230 VAC 3-phase input. They feature class F2 insulation and are rated for continuous duty. They are available with or without a gearhead to achieve the proper torque and speed you desire. Gearbox versions are available in 12.7 and 42 to 1 ratios. They feature precision machined gearing which is hardened for maximum load capabilities. Geared models have oversized output bearings for greater overhung load capacity and longer life. High carbon output shafts provide maximum strength and rigidity. All needle bearing journals are precision ground after heat treating, to provide maximum finish and fit. The gearmotors are designed for mounting at any angle, but shaft up with motor below is not recommended. See compatibility chart on page 66 for recommended AC drives. Optional conduit box and mounting bracket on page 95.

### Dimensions



# Compatibility Chart



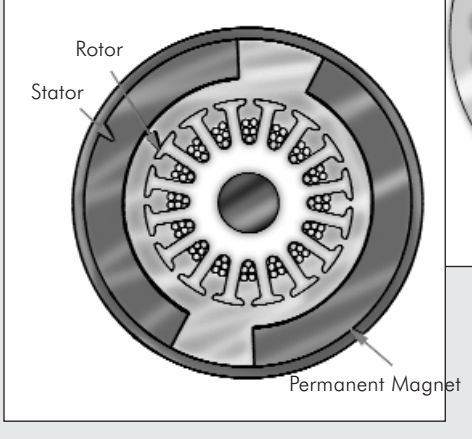
| Voltage AC | 115 | | | | | | | | | 230 | | | | | | | | | 115/230 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RATED HP | 1/15 | | | | | | 1/6 | | | 1/15 | | | | | | 1/6 | | | 1/2 | |
| Motor / Minarik AC Drives | 506-21-001 | 506-21-002 | 506-21-003 | 506-21-004 | 506-21-005 | 506-21-006 | 506-21-007 | 506-21-008 | 506-21-009 | 506-23-001 | 506-23-002 | 506-23-003 | 506-23-004 | 506-23-005 | 506-23-006 | 506-23-007 | 506-23-008 | 506-23-009 | 506-25-001 | 506-25-002 |
| MAC05-D240AC | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MAC05-D240AC-PCM | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| AC111S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC211S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC112S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC212B-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC111S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC211S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC112S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC112T-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC212B-0.2 | | | | | | | | | | | | | | | | | | | X | X |
| AC214T-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC321S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC421S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC322S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC422S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC321T-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC421S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC322T-0.2 | | | | | | | | | | | | | | | | | | | X | X |
| AC422T-0.2 | | | | | | | | | | | | | | | | | | | X | X |
| AC331S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC431S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC332S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC432S-0.2 | | | | | | | | | | | | | | | | | | | X | X |
| AC331S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC431S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC332T-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC432T-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC351S-0.2 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| AC352S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC351S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| AC352S-0.4 | | | | | | | | | | | | | | | | | | | X | X |
| VFD01-230AC | | | | | | | | | | X | X | X | X | X | X | X | X | X | | |
| VFD01-D230AC | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| VFD02-115AC | X | X | X | X | X | X | X | X | X | | | | | | | | | | | |
| VFD02-230AC | | | | | | | | | | X | X | X | X | X | X | X | X | X | | |
| VFD-D230AC | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | |
| VFD04-115AC | | | | | | | X | X | X | | | | | | | | | | X | X |
| VFD04-230AC | | | | | | | | | | | | | | | | X | X | X | X | X |
| VFD04-D230AC | | | | | | | X | X | X | | | | | | | X | X | X | X | X |
| VFD05-D230AC-PCM | | | | | | | X | X | X | | | | | | | | | | X | X |
| VFDA4X04-D230AC-PCM | | | | | | | X | X | X | | | | | | | X | X | X | X | X |
| VFDP4X04-D230AC-PCM | | | | | | | X | X | X | | | | | | | X | X | X | X | X |
| VFDF4X04-D230AC-PCM | | | | | | | X | X | X | | | | | | | X | X | X | X | X |

X = Standard Model

Brushless DC (BLDC) systems combine the positive attributes of AC and DC systems. As a result, their usage in new applications continues to grow. Permanent magnet (PM) designs are the most popular brush type DC motors sold on the market today. They employ permanent magnets on the stator which in turn react with wound electromagnets on the rotor. These DC motors incorporate carbon brushes which slide over and transmit electrical power to the commutator which in turn switches power to the rotor windings to provide smooth rotation. Benefits of this design include a linear speed-torque performance which is easily controlled, a small motor diameter, predictable torque throughout a wide speed range, high starting torque, and minimal wiring.

Depending on the application these self commutating motors may cause electrical noise and are susceptible to brush and commutator maintenance or a finite life expectancy. Users who cannot tolerate this motor maintenance have sometimes opted for AC motors which are brushless, small, and inexpensive. However, AC systems have typically been limited by a narrow speed range, poor torque output at low speeds, and large expensive drives. Minarik has now introduced our AC variable frequency MAC drive to combat these very issues and control these AC motors in a cost effective package.

BLDC motors also address several of the pitfalls of the DC Brush motor, while maintaining the advantages of permanent magnet DC motor performance. BLDC motors are similar to permanent magnet AC synchronous motors with a magnetic rotor and wound stator construction. BLDC wound stators can rapidly dissipate heat to the housing and environment in contrast to PM brush motors which trap the heat under a non-conductive air gap. This results in greater efficiency and power density for the BLDC design and provides high torque-to-inertia ratios.

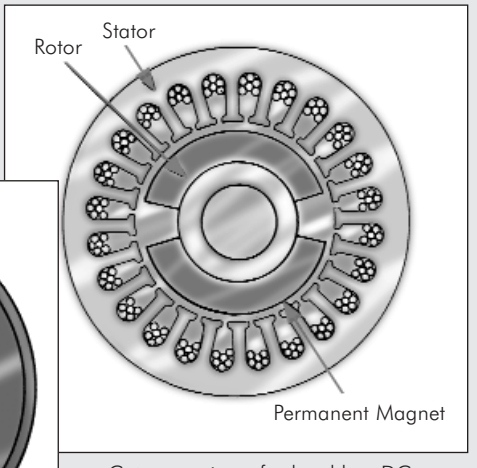



Cut-away view of a conventional permanent-magnet DC motor assembly.

Some common BLDC advantages include:

- Ability to control motors over a wide range of speeds
- Precise speed regulation without additional cost
- Rapid acceleration and deceleration capability
- Starting torque and dynamic response equal to or better than conventional DC drives
- Ability to operate several brushless drives from a common DC bus
- No mechanical wear or conductive brush dust from brushes

Electronic commutation in brushless drives eradicates the need for brushes in the motor, and therefore all associated maintenance. Minarik brushless drives use hall-effect sensors located within the motor to determine the rotor position for proper commutation and determination of which power transistors to turn ON to obtain maximum motor torque. Since commutation now becomes electrical, only motor bearings suffer from mechanical wear. BLDC motors run at higher speeds than PM DC motors because the frictional components of mechanical commutation do not limit their speed and higher efficiencies can be achieved at higher speeds. BLDC motors provide more reliable performance since environmental issues such as humidity or elevation do not play a part in the now non-existent brushes, brush film, voltage drops, and mechanical wear. If properly sized, and properly packaged, your next BLDC motor could handle all your motion control needs AND last you a lifetime.




Cut-away view of a brushless DC motor assembly.

# Low Voltage PWM Brushless DC

## FEATURES & BENEFITS

- **Low voltage:** Designed specifically for low voltage brushless motors (24 - 40 VDC).
- **Reversing:** A low voltage, dry contact switch closure on the terminal will reverse the motor "on the fly".
- **Speed regulation:** 3% regulation of base speed.
- **User adjustable calibration pots:** Minimum and maximum speed.
- **Diagnostic LEDs:** LEDs for Power and Current limit.
- **Quick connect terminal block:** Quick and easy wire terminations.
- **AC or DC input voltage:** Accepts either a DC or AC input power.
- **Switch selectable Hall spacing:** Select either 60° or 120° Hall effect feedback spacing.

### LVBL Series Specifications

| Models | Input Voltage (AC) | Input Voltage (DC) | Output Voltage (VDC) | Cont. Output Current (ADC) | Peak Current (ADC) |
|---|---|---|---|---|---|
| LVBL02-24AC/DC | 24 - 36 | 24 - 40 | 24 - 40 | 2 | 3 |
| LVBL06-24AC/DC | 24 - 36 | 24 - 40 | 24 - 40 | 6 | 9 |

# LVBL Series

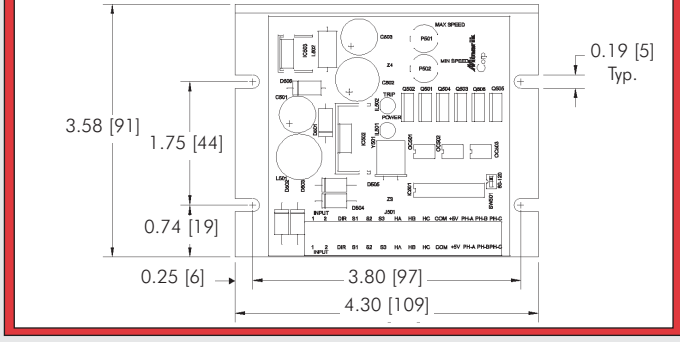
LVBL02-24AC/DC

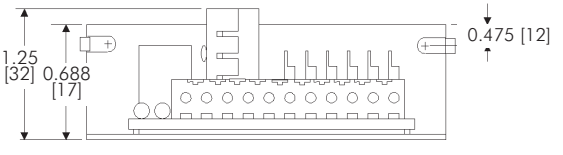
### Typical Applications

- Medical Equipment
- Office Machinery
- Food Processing Equipment
- Packaging Equipment

Minarik's LVBL Series is designed to meet the demands of low voltage brushless motors. The compact chassis is easy to wire and calibrate with its screw-clamp connector and two trimmer pots for maximum and minimum speeds. The low voltage input allows the drive to run directly off the secondary of a transformer (24 - 36 VAC) or from a 24-40 VDC bus. The brushless technology means the application will run extremely quiet and cool while maintaining torque throughout the speed range. A low cost brushless solution is now available in the LVBL Series.

### LVBL Dimensions




All dimensions in inches [millimeters]

## FEATURES & BENEFITS

- **Reversing:** Simple switch wired to terminal block allows you to quickly change directions.
- **Speed range and regulation:** .1% speed regulation over 80:1 speed range.
- **User adjustable calibration pots:** IR compensation, max speed, min speed, current limit, acceleration and deceleration.
- **Diagnostic LEDs:** LEDs for power, fault, torque limit and bus limit.
- **Stopping modes:** The user can brake (N.C.), decelerate (N.O.), or coast the motor to a stop (N.C.).
- **Quick connect terminal block:** Quick and easy wire terminations.
- **On board power supply:** 5VDC, 20mA supply for Hall sensors.
- **22kHz switching frequency:** A high switching frequency means a quiet motor!
- **Accepts AC or DC voltage:** Accepts an AC or DC input voltage.
- **Options and accessories:** BOSSDB-115 for dynamic braking.

### BOSS 1Q Series Specifications

| Models | Input Voltage (VAC) | Input Voltage (VDC) | Max. Current | Max. Output Voltage | Peak Current (amps) | Form Factor | HP Rating |
|---|---|---|---|---|---|---|---|
| BOSS04AC-1Q | 90 - 130 | 100 - 180 | 4 | 130 | 8 | 1.025 | 1/2 |
| BOSS08AC-1Q | 90 - 130 | 100 - 180 | 8 | 130 | 16 | 1.025 | 1 |
| BOSS15AC-1Q | 90 - 130 | 100 - 180 | 15 | 130 | 30 | 1.025 | 2 |

# BOSS 1Q Series

Minarik's BOSS Series of brushless drives provides an exciting alternative to both AC and DC drives for motor velocity control in applications 1/2 to 2 Hp. BOSS drives incorporate the desirable attributes of AC and DC systems: Little or no maintenance (no brushes); compact, cool running, and quiet motor operation; excellent speed range (80:1); .1% speed regulation; quick response; high speeds; superb low-end torque; and no audible switching noise.

Electrically commutated motors are driven from a three phase "DC" output (trapezoidal waveform). Standard drives output 4, 8, or 15 amps continuous with peak currents reaching 200% of continuous rating for one second. BOSS drives use hall-effect feedback, 60° or 120° spacing, for accurate system operation.

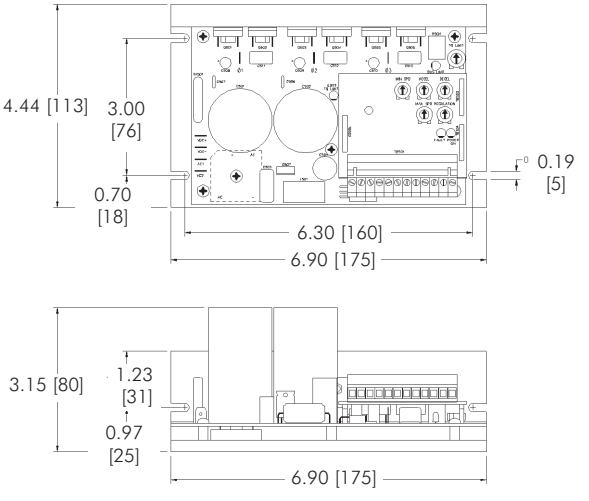
A removable daughter card (personality module) lets users add additional features to the BOSS drives and creates a highly versatile product. Diagnostics include a green power LED; a red current limit LED to indicate continuous current limit; a red fault LED to indicate open or mis-wired hall effect sensors, phase-to-phase short-circuit, and peak current limit.

### Typical Applications

- HVAC
- Machine Tools
- Medical Equipment
- Printing
- Food Processing
- Office Machinery
- Specialty Machinery

BOSS15AC-1Q

### BOSS 1Q Dimensions




All dimensions in inches [millimeters]

# 1/2 to 2 Hp
# PWM Brushless DC 4 Quadrant

## FEATURES & BENEFITS

- **4Q reversing:** Regenerative or 4-quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **Speed range and regulation:** .1% speed regulation over 80:1 speed range in voltage or velocity mode. .05% over 100:1 speed range in tachometer mode.
- **User adjustable calibration pots:** IR compensation, forward max speed, reverse max speed, min speed, acceleration, deceleration, reverse current limit, forward current limit, zero offset, gain and tachometer.
- **Diagnostic LEDs:** LEDs for Power and Fault.
- **Stopping modes:** The user can regeneratively brake (N.O.) or coast the motor to a stop (N.C.).
- **Quick connect terminal block:** Quick and easy wire terminations!
- **Four operating modes:** Voltage mode (no feedback), velocity mode, tachometer feedback mode and current mode.†
- **High switching frequency:** Power devices switch at 22kHz resulting in a very quiet motor!
- **Option and Accessories:** BOSSDB-115 or BOSSDB230 regen dump circuits.

**BOSS 4Q Series Specifications**

| Models | Input Voltage (VAC) | Input Voltage (VDC) | Output Current | Output Voltage | Peak Current (amps) | Hp Rating | Height (A) |
|---|---|---|---|---|---|---|---|
| BOSS04-D240AC-4Q | 90 - 240 | 100-360 | 4 | 130 - 240 | 8 | 1/2 - 1 | 3.87 (98) |
| BOSS08-D240AC-4Q | 90 - 240 | 100-360 | 8 | 130 - 240 | 16 | 1 - 2 | 3.87 (98) |
| BOSS15-115AC-4Q | 90 - 120 | 100-180 | 15 | 130 | 30 | 2 | 2.62 (67) |

BOSSDB-115 or BOSSDB-230 circuits may be used to increase the regenerative performance of these drives.
† 1kHz bandwidth response. BOSSxx-D240AC-CM drives are available with quicker response ( up to 3kHz bandwidth) and isolation for applications with front-end controllers.

# BOSS 4Q Series

BOSS15-115AC-4Q

## Typical Applications

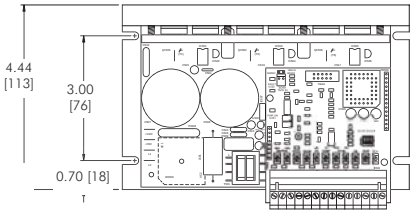
- Material Handling
- Pumps
- Office Machinery
- Packaging
- Conveyors
- Exercise Equipment

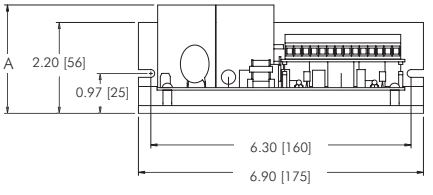
Minarik's BOSS Series of brushless DC drives provides regenerative braking from 1/2 to 2 Hp. BOSS drives incorporate the desirable attributes of AC and DC systems; little or no maintenance (no brushes); compact, cool running, and quiet motor; better than 1% speed regulation; quick response; high speeds; superb low-end torque; and no audible switching noise.

The BOSS 4Q can be run in four different modes; voltage mode when using external velocity controllers to avoid "fighting"; velocity mode which uses both the internal voltage and velocity loop for excellent regulation; tach mode for use with tachogenerator feedback of 7-50V/Krpm for good low-end speed control; and current mode with a 1kHz bandwidth for controlling torque, excellent with front-end controllers.

A 10-pin male connector provides non-isolated drive diagnostic outputs. A user may obtain the following information: run/stop indication, tachometer output proportional to speed, fault indication, average RMS current out and phase current out.

## BOSS 4Q Dimensions




All dimensions in inches [millimeters]

## FEATURES & BENEFITS

- **Current mode operation only:** Designed for use with front-end servo controllers only.
- **4Q reversing:** Regenerative or 4 quadrant drives have the ability to perform quick, contactorless reversing on-the-fly!
- **Isolated inputs:** Accepts floating or grounded signals either 0- ± 10VDC or a 22-25kHz PWM signal.
- **User adjustable calibration pot:** Current limit.
- **Diagnostic LEDs:** LEDs for Power and fault.
- **Stopping modes:** Regenerative braking (N.O.) with an external dumping circuit available for handling the most demanding of regen braking applications and coast to a stop (N.C.).
- **Quick connect terminal block:** Quick and easy wire termination.
- **High bandwidth:** Up to 3kHz bandwidth for high performance.
- **Modular designs:** Same power board as BOSS-1Q and BOSS-4Q.
- **Accepts AC or DC voltage:** Accepts an AC input or DC input voltage of 100-360VDC.
- **Options & Accessories:** BOSSDB-115 or BOSSDB-230 regen dump circuits.

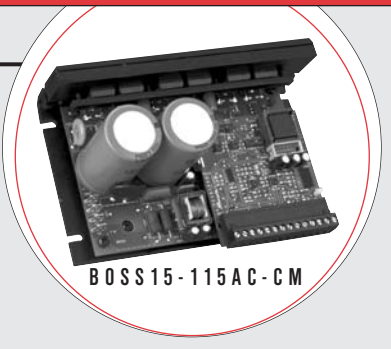
## BOSS CM Series Specifications

| Models | Input Voltage (VAC) | Input Voltage (VDC) | Output Current | Max Output Voltage | Peak Current (Amps) | Hp Rating | Height (A) |
|---|---|---|---|---|---|---|---|
| BOSS04-D240AC-CM | 90 - 240 | 100-360 | 4 | 130 - 240 | 8 | 1/2 - 1 | 3.87 (98) |
| BOSS08-D240AC-CM | 90 - 240 | 100-360 | 8 | 130 - 240 | 16 | 1 - 2 | 3.87 (98) |
| BOSS15-115AC-CM | 90 - 120 | 100-360 | 15 | 130 | 30 | 2 | 2.62 (67) |

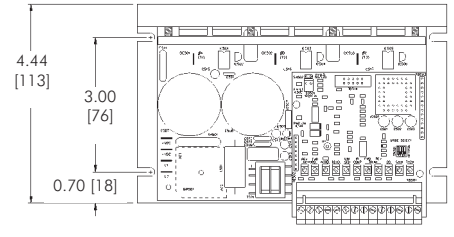
# BOSS CM Series

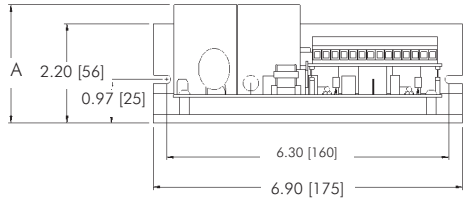
## Typical Applications

- Material Handling
- Office Machinery
- Film Processing
- Packaging Machinery
- Elevated Conveying
- Wrapping
- Sealing


BOSS15-115AC-CM

## BOSS CM Dimensions




All dimensions in inches [millimeters]

All BOSS drives incorporate the desirable attributes of AC and DC systems; low maintenance due to no brushes, compact, cool running quiet motor; good speed regulation, quick response, high speeds, superb low-end torque, all with no audible switching noise! With Minarik's BOSS-4Q and CM Series of brushless drives you also get the added benefit of regenerative operation and braking from 1/2 to 2 Hp.

The CM personality card plugged into the BOSS power board turns the BOSS into a high-bandwidth (up to 3kHz) servo amplifier. When combined with a front-end servo controller, the BOSS-CM makes a very robust and responsive servo system. The BOSS-CM needs no calibration other than a current limit setting, and can accept either a 0- ±10VDC or PWM (22-25kHz) reference signal.

The BOSS-CM has the same mounting footprint and terminal block layout as the BOSS-4Q. Making it easy to upgrade from the BOSS-4Q (operating in current mode) to the BOSS-CM and get even better performance.

## FEATURES & BENEFITS

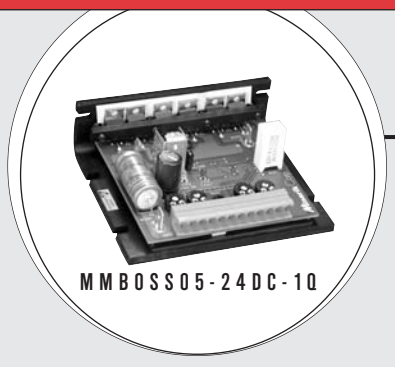
- **MM footprint:** Extremely compact size with an industry standard mounting footprint.
- **Reversing:** Simple switch wired to terminal block allows you to quickly change direction.
- **Speed range and regulation:** 0.1% speed regulation over 80:1 speed range.
- **User adjustable calibration pots:** Min speed, max speed, current limit and gain.
- **Diagnostic LEDs:** LEDs for power and fault.
- **Stopping Modes:** Brake to a stop (N.C.) or coast to a stop (N.O.) with simple switches wired to terminal block.
- **Enable/disable:** Open for enable, close for disable.
- **Quick connect terminal block:** Provides for quick and easy wire terminations.
- **On board power supply:** 5VDC, 20mA for Hall sensors.
- **22kHz switching frequency:** A high frequency means a quiet motor!
- **DC voltage input:** Accepts a DC input of 12-40VDC. (Provides output that is 90% of DC input.)

### MMBOSS Series Specifications

| Models | DC Input Voltage (VDC) | Max. Cont. Phase Current (RMS) | Max. Cont. Phase Current Limit (RMS) | Peak Phase Current Limit for 1 sec. (RMS) | Max. Output Voltage (RMS) |
|---|---|---|---|---|---|
| MMBOSS05-24DC-1Q | 12-40VDC | 5A | 7.5A | 10A | 0-90% of input voltage |

Notes: 1) 155C winding temp., all others at 25C; 2) The tolerance on winding constants and resistance (+/-10%), inductance (+/-15%);
3) Peak current is calculated and does not take into effect non-Linearities of the Kt

# MMBOSS Series

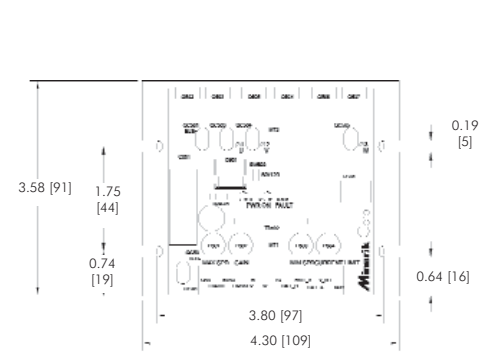


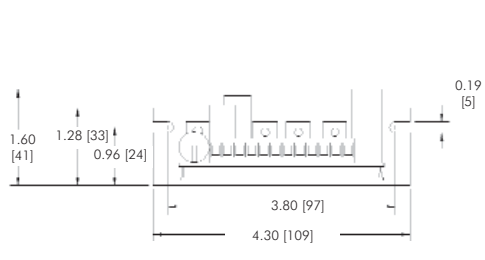

### Typical Applications

- Conveying
- Printing
- Winding
- Labeling
- Material Handling
- Packaging Machinery

The MMBOSS is similar in functionality and performance to the BOSS-1Q Series, while fitting into the MM footprint (an industry standard hole pattern). The MMBOSS accepts a 12-40VDC input and provides a three phase, trapezoidal DC output for use with brushless motors using Hall sensors (with 60 or 120 degrees electrical spacing). The MMBOSS is the perfect solution for low voltage, brushless motors requiring speed control such as packaging, conveying, and wrapping applications.

### MMBOSS Dimensions




All dimensions in inches [millimeters]

## FEATURES & BENEFITS

- Precision balanced rotors and precision bearings for quiet operation.
- Precision machined dimensions.
- Samarium Cobalt or Neodymium Iron Boron high-energy rare earth permanent magnets.
- Low rotor inertias.
- Keyed shaft.
- TENV, IP65 rating.
- IP64 shaft rating.
- Class F insulation.
- Metric frame sizes 55, 70, 92 and 115 mm.
- Nema frame sizes 23, 34, and 42.
- Integral Hall-effect sensors.
- Thermal sensors on windings of -3XX(N) and -4XX(N) motors.
- Optional encoder with commutation tracks available.
- Optional connectors.

# BOSS Motor Series

**BOSS Motor Series***

| Model No. | Output Voltage from Minarik brushless drive (V) | Matched Minarik BOSS Brushless Drive | No Load Max Speed at rated voltage (RPM) | Torque Constant (Kt = in-lb/A) | Ke (Volts per kRPM) | Drive-Motor system continuous torque (in-lb) | Drive-Motor system peak torque (in-lb) | Metric Frame Size in mm | Nema Frame Size (N suffix) |
|---|---|---|---|---|---|---|---|---|---|
| 530-XX-210(N) | 24* | LVBL02/06, MMBOSS05 | 2500 | 1.6 | 8 | 1.4 | 3.5 | 55 | 23 |
| 530-XX-230(N) | 24* | LVBL02/06, MMBOSS05 | 1800 | 3.1 | 11 | 2.7 | 7.4 | 55 | 23 |
| 530-XX-212 | 24* | LVBL06 | 2500 | 4.9 | 8 | 3.5 | 6.3 | 70 | N/A |
| 530-XX-270(N) | 130/260 | BOSS04 (115 or 230VAC) | 2000/3000 | 6 | 64 | 6.0/5.3 | 22.7/26.0 | 55 | 23 |
| 530-XX-312(N) | 130/260 | | 2000/3000 | 7 | 44 | 7.0/5.2 | 18.4/22.0 | 92 | 34 |
| 530-XX-272(N) | 130 | | 2500 | 6 | 88 | 5.3 | 26 | 55 | 23 |
| 530-XX-330(N) | 260 | | 2500 | 13.3 | 64 | 11.1 | 53 | 92 | 34 |
| 530-XX-332(N) | 130/260 | | 2000/3000 | 13.3 | 64 | 13.3/11.1 | 43.0/43.0 | 92 | 34 |
| 530-XX-352(N) | 130/260 | | 2000/3000 | 19 | 64 | 19.0/17.7 | 43.0/43.0 | 92 | 34 |
| 530-XX-334(N) | 130/260 | | 2500/4000 | 13.3 | 44 | 11.1/11.1 | 30.0/30.0 | 92 | 34 |
| 530-XX-372(N) | 130/260 | | 2000/3000 | 27 | 64 | 21.6/21.3 | 43.0/43.0 | 92 | 34 |
| 530-XX-354(N) | 130 | BOSS08 (115 or 230VAC) | 2500 | 19 | 44 | 17.7 | 26 | 92 | 34 |
| 530-XX-374(N) | 130 | | 2500 | 27 | 44 | 21.3 | 59 | 92 | 34 |
| 530-XX-430(N) | 260 | | 2500 | 60 | 88 | 46.1 | 118 | 115 | 42 |
| 530-XX-420(N) | 130/260 | | 2000/2500 | 46 | 64 | 43.2/37.2 | 86.0/86.0 | 115 | 42 |
| 530-XX-426(N) | 260 | | 2500 | 46 | 88 | 37.2 | 118 | 115 | 42 |
| 530-XX-412(N) | 130 | | 2500 | 33 | 44 | 28.4 | 59 | 115 | 42 |
| 530-XX-432(N) | 130 | BOSS15 (115 VAC) | 2000 | 60 | 64 | 60 | 162 | 115 | 42 |
| 530-XX-412(N) | 130 | | 2500 | 33 | 44 | 28.4 | 94 | 115 | 42 |
| 530-XX-422(N) | 130 | | 2500 | 46 | 44 | 37.2 | 111 | 115 | 42 |

*Additional specifications are on page 74-79 including ratings when matched to Minarik brushless drives.
Note:1) Tolerance on resistance and inductance is ±10%. Tolerance on Ke and Kt values are ±15%/-5%

## FEATURES & BENEFITS

- **Compatible with Minarik LVBL and MMBOSS drives.**
- Samarium Cobalt permanent magnets.
- Insulation Class F.
- IP65, TENV enclosure.
- IP64, shaft rating.
- Keyed shaft.
- 55mm frame size.
- Nema 23 mounting with "N" suffix.
- Flying leads.

### BOSS Motor Specifications*

| Model No. | Max Terminal Voltage (VDC) | Max Speed No Load (RPM) | Torque | | Current | | Res. (ohms) | Ind. (mH) | Inertia (in-lb-s²) | Cont. Torque with Minarik Drive (in-lb)* | Therm. (°C/W) | Weight (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak (in-lb) | Cont. (in-lb) | Peak (A) | Cont. (A) | | | | | | |
| 530-XX-210(N) | 64 | 8000 | 6.3 | 1.6 | 10.4 | 2.4 | 3.9 | 3.2 | .00017 | 1.4 | 3.6 | 2.9 |
| 530-XX-230(N) | 88 | 8000 | 12.7 | 3.1 | 15.0 | 3.3 | 2.5 | 2.5 | .00021 | 2.7 | 2.6 | 3.3 |
| 530-XX-212 | 66 | 8000 | 22 | 4.9 | 35 | 7.2 | .57 | .96 | .00038 | 3.5 | 2.6 | 4.9 |

*Additional specifications are on page 73, including ratings when matched to Minarik brushless drives.
Note:1) Tolerance on resistance and inductance is ±10%. Tolerance on Ke and Kt values are ±15%/-5%

# BOSS Motor Series

**Feedback Devices (XX). Standard is 04**

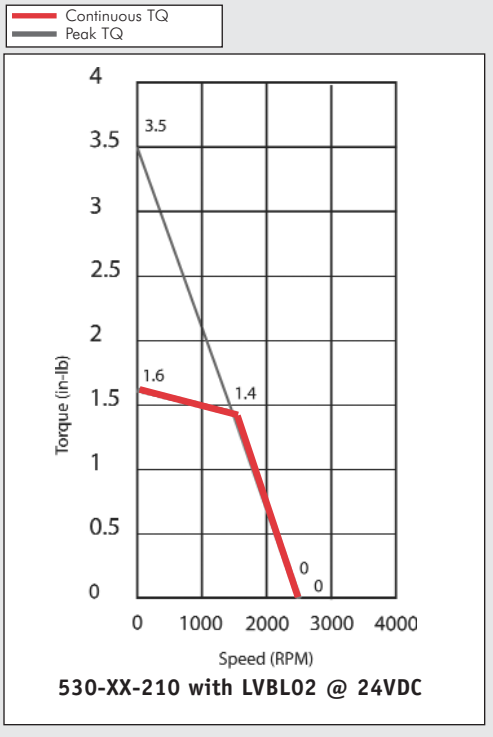
- 04 = Hall Effect sensor feedback
- 10 = 1000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.
- 20 = 2000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.

The BOSS brushless motor series is a comprehensive motor line designed for use in a variety of demanding applications.

Brushless motors have no brushes to wear out or maintain. High quality ball bearings are the only mechanical linkage between the stator and rotor. Commutation is achieved through a feedback device such as Hall Effect sensors or an encoder. These high-energy servomotors provide premium performance by combining Samarium Cobalt magnets with low inertia rotors giving excellent acceleration and deceleration characteristics. In addition, Samarium Cobalt magnets have a high resistance to demagnetization allowing for operation in high peak torque applications.

The BOSS motors specifically listed on this page are for use with low voltage, trapezoidal DC drives. They are the perfect match for Minarik's LVBL and MMBOSS low voltage DC brushless drives.

If your application requires additional torque, Gator gear heads mount directly to the BOSS Nema (N) versions.




**530-XX-210 with LVBL02 @ 24VDC**

*Additional Speed Torque Curves are on page 80-82.

## FEATURES & BENEFITS

- **Compatible with BOSS04 brushless drives.**
- Samarium Cobalt permanent magnets.
- Insulation Class F.
- IP65, TENV enclosure.
- IP64, shaft rating.
- Keyed shaft.
- 55mm (2XX) and 92mm (3XX) frame sizes.
- Nema 23 (on 55mm) or Nema 34 (on 92mm) with "N" suffix.
- Flying leads.

**BOSS Motor Specifications***

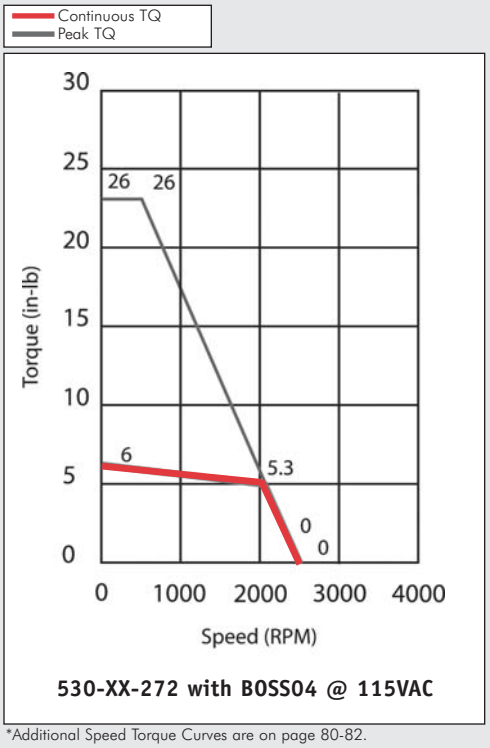
| Model No. | Max Terminal Voltage (VDC) | Max Speed No Load (RPM) | Torque | | Current | | Res. (ohms) | Ind. (mH) | Inertia (in-lbs²) | Cont. Torque with BOSS04 Drive (in-lb)* | Therm. (°C/W) | Weight (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak (in-lb) | Cont. (in-lb) | Peak (A) | Cont. (A) | | | | | | |
| 530-XX-270(N) | 390 | 8000 | 26 | 6 | 5.6 | 1.1 | 30 | 38 | .00031 | 6.0 (5.3) | 2.2 | 4.4 |
| 530-XX-272(N) | 350 | 8000 | 26 | 6 | 7.6 | 1.6 | 14 | 16 | .00031 | 5.3 | 2.2 | 4.4 |
| 530-XX-312(N) | 380 | 6000 | 22 | 7 | 5.9 | 1.1 | 37 | 114 | .00079 | 7.0 (5.2) | 1.7 | 7.7 |
| 530-XX-330(N) | 530 | 6000 | 53 | 13.3 | 8.8 | 1.8 | 18 | 82 | .00113 | 11.1 | 1.35 | 9.5 |

*Additional specifications are on page 73, including ratings when matched to Minarik brushless drives.
Note:1) Tolerance on resistance and inductance is ±10%. Tolerance on Ke and Kt values are ±15%/-5%

# BOSS Motor Series

**Feedback Devices (XX). Standard is 08**

- 08 = Hall Effect sensor feedback
- 10 = 1000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.
- 20 = 2000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.




**530-XX-272 with BOSS04 @ 115VAC**

*Additional Speed Torque Curves are on page 80-82.

The BOSS brushless motor series is a comprehensive motor line designed for use in a variety of demanding applications.

Brushless motors have no brushes to wear out or maintain. High quality ball bearings are the only mechanical linkage between the stator and rotor. Commutation is achieved through a feedback device such as Hall Effect sensors or an encoder.

These high-energy servomotors provide premium performance by combining Samarium Cobalt magnets with low inertia rotors giving excellent acceleration and deceleration characteristics. In addition, Samarium Cobalt magnets have a high resistance to demagnetization allowing for operation in high peak torque applications.

Although the BOSS motors on this page can be used with other trapezoidal brushless DC drives we recommend they be matched with our BOSS04 brushless DC drives. (See specs on page 73)

If your application requires additional torque, Gator gear heads mount directly to the BOSS Nema (N) versions.

## FEATURES & BENEFITS

- **Compatible with BOSS04 brushless drives.**
- Samarium Cobalt permanent magnets.
- Insulation Class F.
- IP65, TENV enclosure.
- IP64, shaft rating.
- Keyed shaft.
- 92mm frame sizes.
- Nema 34 mountings with "N" suffix.
- Flying leads.
- Thermal sensors.

### BOSS Motor Specifications*

| Model No. | Max Terminal Voltage (VDC) | Max No Load Speed (RPM) | Torque | | Current | | Res. (ohms) | Ind. (mH) | Inertia (in-lbs²) | Cont. Torque with BOSS04 Drive (in-lb)* | Therm. (°C/W) | Weight (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak (in-lb) | Cont. (in-lb) | Peak (A) | Cont. (A) | | | | | | |
| 530-XX-332(N) | 380 | 6000 | 53 | 13.3 | 12.2 | 2.4 | 10.4 | 43 | .00113 | 13.3 (11.1) | 1.35 | 9.5 |
| 530-XX-334(N) | 260 | 6000 | 53 | 13.3 | 18 | 4.8 | 4.6 | 20 | .00113 | 11.1 (11.1) | 1.35 | 9.5 |
| 530-XX-352(N) | 380 | 6000 | 76 | 19 | 18 | 3.6 | 5.4 | 30 | .0015 | 19.0 (17.7) | 1.09 | 11.5 |
| 530-XX-372(N) | 380 | 6000 | 104 | 27 | 24 | 4.9 | 3.4 | 19 | .0018 | 21.6 (21.3) | .99 | 12.8 |

*Additional specifications are on page 73, including ratings when matched to Minarik brushless drives. Note:1) Tolerance on resistance and inductance is ±10%. Tolerance on Ke and Kt values are ±15%/-5%

# BOSS Motor Series

The BOSS brushless motor series is a comprehensive motor line designed for use in a variety of demanding applications.

Brushless motors have no brushes to wear out or maintain. High quality ball bearings are the only mechanical linkage between the stator and rotor. Commutation is achieved through a feedback device such as Hall Effect sensors or an encoder.

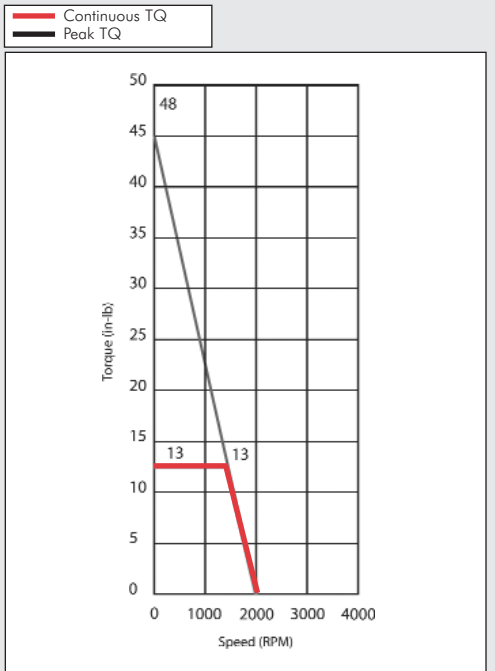
These high-energy servomotors provide premium performance by combining Samarium Cobalt magnets with low inertia rotors giving excellent acceleration and deceleration characteristics. In addition, Samarium Cobalt magnets have a high resistance to demagnetization allowing for operation in high peak torque applications.

Although the BOSS motors on this page can be used with other trapezoidal brushless DC drives we recommend they be matched with our BOSS04 brushless DC drives.

If your application requires additional torque, Gator gear heads mount directly to the BOSS Nema (N) versions.

**Feedback Devices (XX). Standard is 08**

- 08 = Hall Effect sensor feedback
- 10 = 1000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.
- 20 = 2000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.




**530-XX-332 with BOSS04 @ 115VAC**

*Additional Speed Torque Curves are on page 80-82.

## FEATURES & BENEFITS

- **Compatible with BOSS08 brushless drives.**
- Samarium Cobalt permanent magnets.
- Insulation Class F.
- IP65, TENV enclosure.
- IP64, shaft rating.
- Keyed shaft.
- 92mm frame sizes.
- Nema 34 mounting with "N" suffix.
- Flying leads.
- Thermal sensors.

**Boss Motor Specifications**

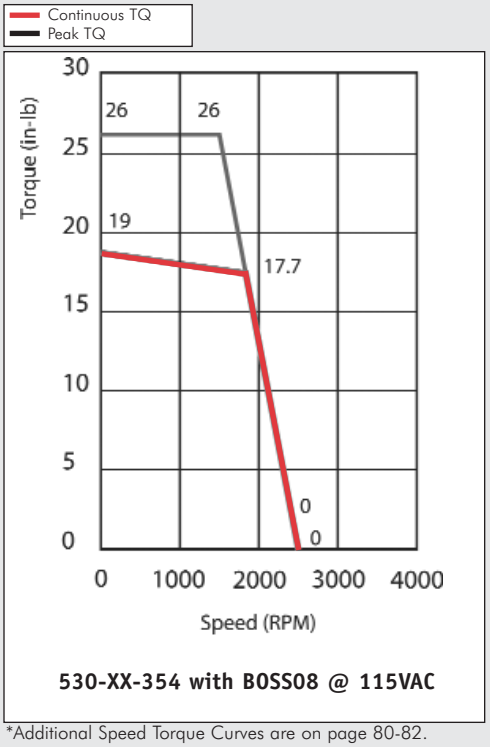
| Model No. | Max Terminal Voltage (VDC) | Max Mechanical Speed (RPM) | Torque | | Current | | Res. (ohms) | Ind. (mH) | Inertia (in-lb-s²) | Cont. Torque with BOSS08 Drive (in-lb)* | Therm. (°C/W) | Weight (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak (in-lb) | Cont. (in-lb) | Peak (A) | Cont. (A) | | | | | | |
| 530-08-354(N) | 260 | 6000 | 26 | 19 | 25 | 5.2 | 2.8 | 14 | .00015 | 17.7 | 1.09 | 11.5 |
| 530-08-374(N) | 260 | 6000 | 104 | 27 | 35 | 7.1 | 1.5 | 8.9 | .00018 | 21.3 | .99 | 12.8 |

*Additional specifications are on page 73, including ratings when matched to Minarik brushless drives.
Note:1) Tolerance on resistance and inductance is ±10%. Tolerance on Ke and Kt values are ±15%/-5%

# BOSS Motor Series

**Feedback Devices (XX). Standard is 08**

- 08 = Hall Effect sensor feedback
- 10 = 1000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.
- 20 = 2000 ppr encoder ith U,V,W, commutation tracks, line driver output, +5VDC, 20mA.




**530-XX-354 with BOSS08 @ 115VAC**

*Additional Speed Torque Curves are on page 80-82.

The BOSS brushless motor series is a comprehensive motor line designed for use in a variety of demanding applications.

Brushless motors have no brushes to wear out or maintain. High quality ball bearings are the only mechanical linkage between the stator and rotor. Commutation is achieved through a feedback device such as Hall Effect sensors or an encoder.

These high-energy servomotors provide premium performance by combining Samarium Cobalt magnets with low inertia rotors giving excellent acceleration and deceleration characteristics. In addition, Samarium Cobalt magnets have a high resistance to demagnetization allowing for operation in high peak torque applications.

Although the BOSS motors on this page can be used with other trapezoidal brushless DC drives we recommend they be matched with our BOSS08 brushless DC drives.

If your application requires additional torque, Gator gear heads mount directly to the BOSS Nema (N) versions.

## FEATURES & BENEFITS

- **Compatible with BOSS08 brushless drives.**
- Neodymium Iron Boron permanent magnets.
- Insulation Class F.
- IP65, TENV enclosure.
- IP64, shaft rating.
- Keyed shaft.
- 115mm frame sizes.
- Nema 42 mountings with "N" suffix.
- Flying leads.
- Thermal sensors.

### BOSS Motor Specifications*

| Model No. | Max Terminal Voltage (VDC) | Max No Load Speed (RPM) | Torque | | Current | | Res. (ohms) | Ind. (mH) | Inertia (in-lbs²) | Cont. Torque with BOSS08 Drive (in-lb)* | Therm. (°C/W) | Weight (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak (in-lb) | Cont. (in-lb) | Peak (A) | Cont. (A) | | | | | | |
| 530-XX-412(N) | 260 | 6000 | 94 | 33 | 30 | 8.8 | 1.29 | 6.9 | .0025 | 28.4 | .79 | 15 |
| 530-XX-420(N) | 380 | 6000 | 139 | 46 | 50 | 8.5 | 1.5 | 9.4 | .0035 | 43.2 (37.2) | .74 | 17 |
| 530-XX-426(N) | 530 | 6000 | 139 | 46 | 22 | 6.2 | 2.9 | 18 | .0035 | 37.2 | .74 | 17 |
| 530-XX-430(N) | 530 | 6000 | 180 | 60 | 29 | 8.1 | 1.7 | 12.6 | .0046 | 46.1 | .7 | 20 |

*Additional specifications are on page 73, including ratings when matched to Minarik brushless drives.
Note:1) Tolerance on resistance and inductance is ±10%. Tolerance on Ke and Kt values are ±15%/-5%

# BOSS Motor Series

**Feedback Devices (XX). Standard is 08**

- 08 = Hall Effect sensor feedback
- 10 = 1000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.
- 20 = 2000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.

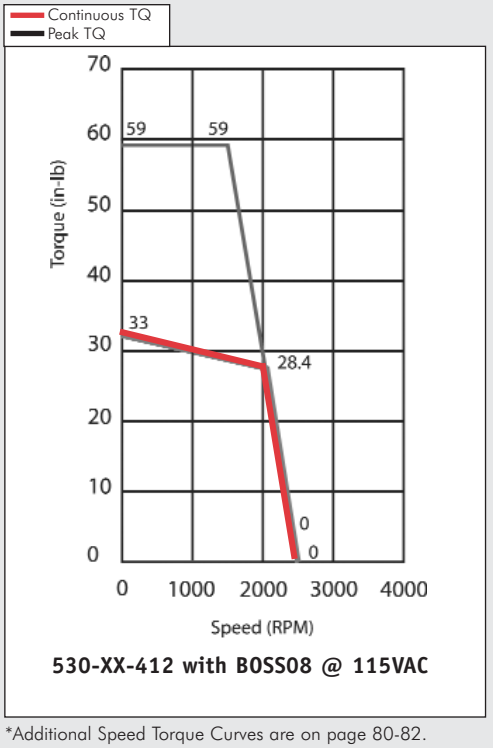
The BOSS brushless motor series is a comprehensive motor line designed for use in a variety of demanding applications.

Brushless motors have no brushes to wear out or maintain. High quality ball bearings are the only mechanical linkage between the stator and rotor. Commutation is achieved through a feedback device such as Hall Effect sensors or an encoder.

These high-energy servomotors provide excellent and cost effective performance by combining Neodymium Iron Boron magnets with low inertia rotors.

Although the BOSS motors on this page can be used with other trapezoidal brushless DC drives we recommend they be matched with our BOSS08 brushless DC drives.

If your application requires additional torque, Gator gear heads mount directly to the BOSS Nema (N) versions.




**530-XX-412 with BOSS08 @ 115VAC**

*Additional Speed Torque Curves are on page 80-82.

## FEATURES & BENEFITS

- **Compatible with BOSS15 brushless drives.**
- Neodymium Iron Boron permanent magnets.
- Insulation Class F.
- IP65, TENV enclosure.
- IP64, shaft rating.
- Keyed shaft.
- 115mm frame sizes.
- Nema 42 mounting with "N" suffix.
- Flying leads.
- Thermal sensors.

## BOSS Motor Specifications*

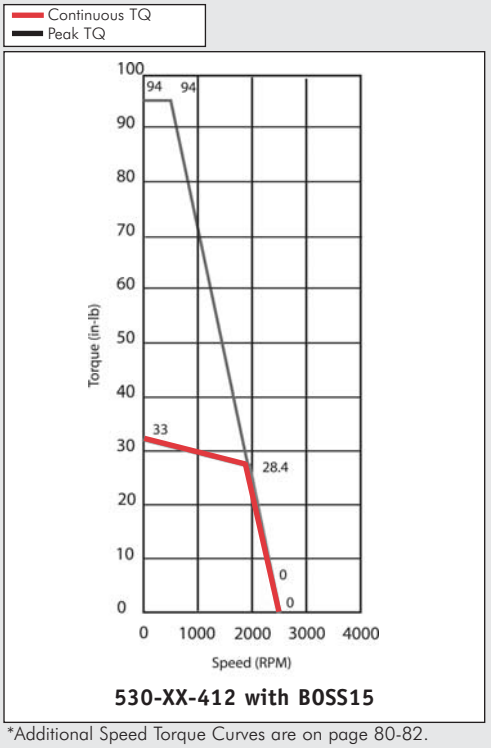
| Model No. | Max Terminal Voltage (VDC) | Max Speed No Load (RPM) | Torque | | Current | | Res. (ohms) | Ind. (mH) | Inertia (in-lb-s²) | Cont. Torque with Minarik BOSS15 Drive (in-lb)* | Therm. (°C/W) | Weight (lb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak (in-lb) | Cont. (in-lb) | Peak (A) | Cont. (A) | | | | | | |
| 530-XX-412(N) | 260 | 6000 | 94 | 33 | 30 | 8.8 | 1.29 | 6.9 | .0025 | 28.4 | .79 | 15 |
| 530-XX-422(N) | 260 | 6000 | 139 | 46 | 44 | 12.4 | .72 | 4.4 | .0035 | 37.2 | .74 | 17 |
| 530-XX-432(N) | 380 | 6000 | 180 | 60 | 41 | 11.1 | .9 | 6.7 | .0046 | 60.0 | .7 | 20 |

*Additional specifications are on page 73, including ratings when matched to Minarik brushless drives.
Note:1) Tolerance on resistance and inductance is ±10%. Tolerance on Ke and Kt values are ±15%/-5%

# BOSS Motor Series

**Feedback Devices (XX). Standard is 08**

- 08 = Hall Effect sensor feedback
- 10 = 1000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.
- 20 = 2000 ppr encoder with U,V,W, commutation tracks, line driver output, +5VDC, 20mA.




**530-XX-412 with BOSS15**

*Additional Speed Torque Curves are on page 80-82.

The BOSS brushless motor series is a comprehensive motor line designed for use in a variety of demanding applications.

Brushless motors have no brushes to wear out or maintain. High quality ball bearings are the only mechanical linkage between the stator and rotor. Commutation is achieved through a feedback device such as Hall Effect sensors or an encoder.

These high-energy servomotors provide excellent and cost effective performance by combining Neodymium Iron Boron magnets with low inertia rotors.

Although the BOSS motors on this page can be used with other trapezoidal brushless DC drives we recommend they be matched with our BOSS15 brushless DC drives.

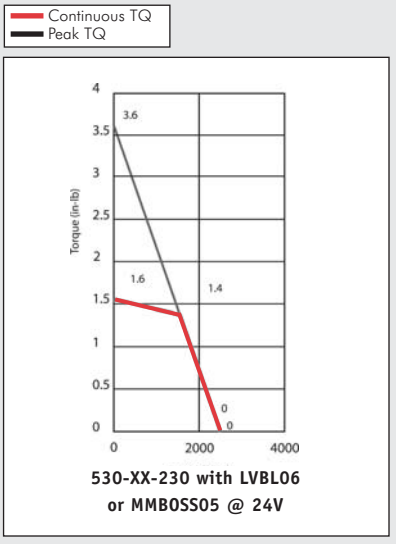
If your application requires additional torque, Gator gear heads mount directly to the BOSS Nema (N) versions.

# Speed Torque Curves

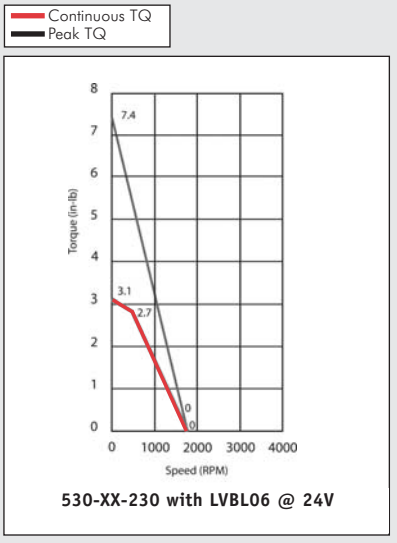


**Torque loss or torque rippling may occur when running in velocity mode at speeds under 300 RPM.**

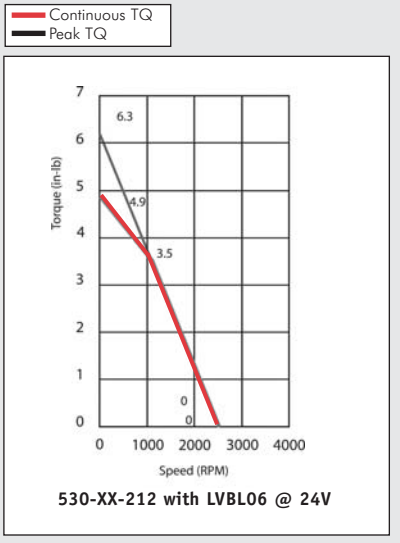
**Cogging may also occur at speeds less than 300 RPM**



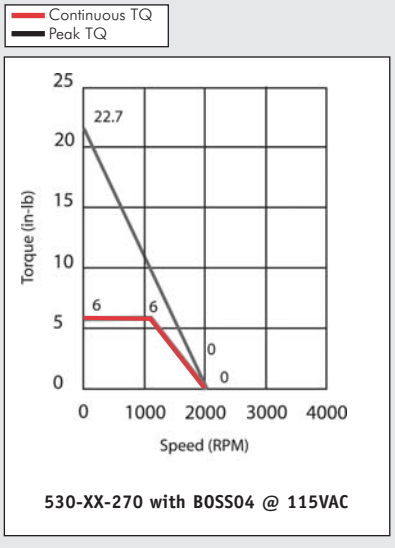

**530-XX-230 with LVBL06 or MMBOSS05 @ 24V**



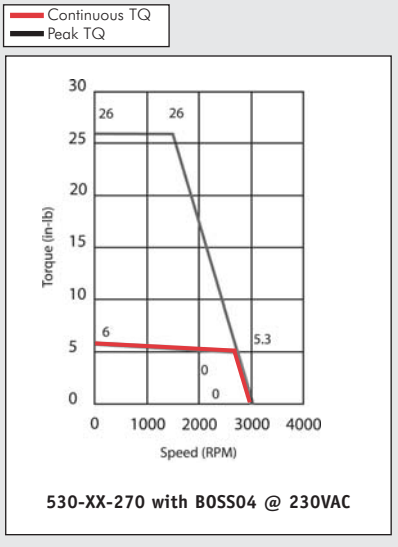

**530-XX-230 with LVBL06 @ 24V**



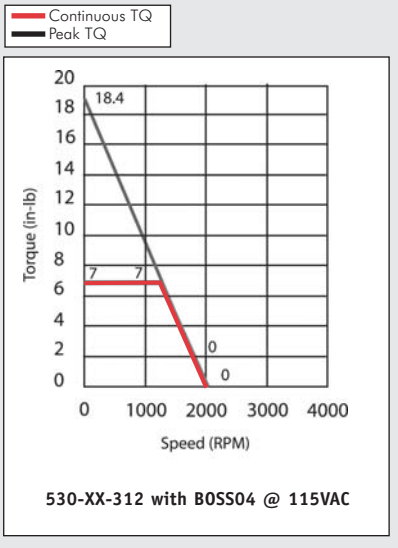

**530-XX-212 with LVBL06 @ 24V**



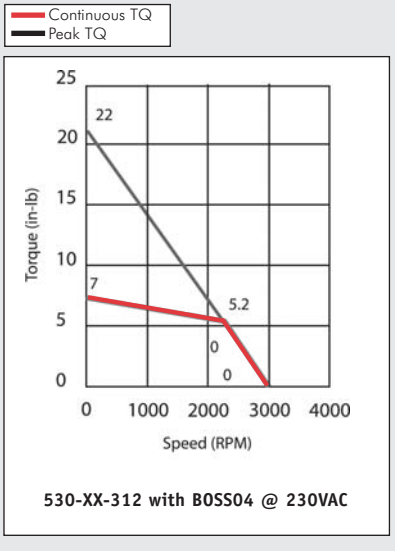

**530-XX-270 with BOSS04 @ 115VAC**



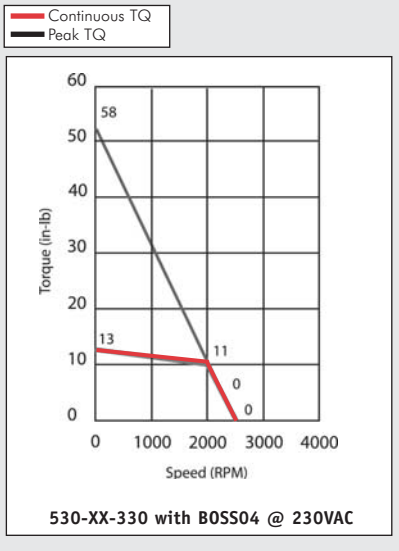

**530-XX-270 with BOSS04 @ 230VAC**



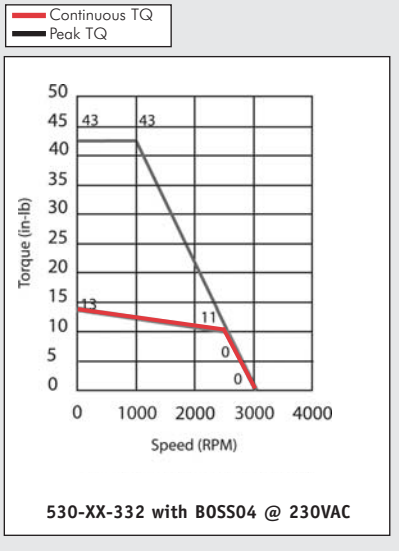

**530-XX-312 with BOSS04 @ 115VAC**




**530-XX-312 with BOSS04 @ 230VAC**




**530-XX-330 with BOSS04 @ 230VAC**



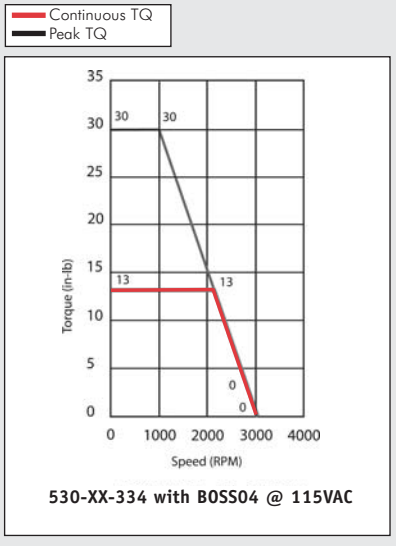

**530-XX-332 with BOSS04 @ 230VAC**

# Speed Torque Curves

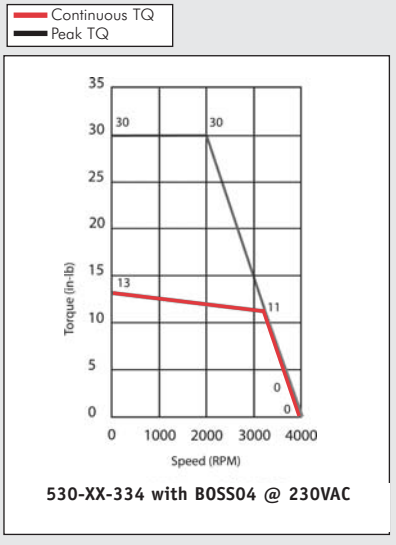


**Torque loss or torque rippling may occur when running in velocity mode at speeds under 300 RPM.**

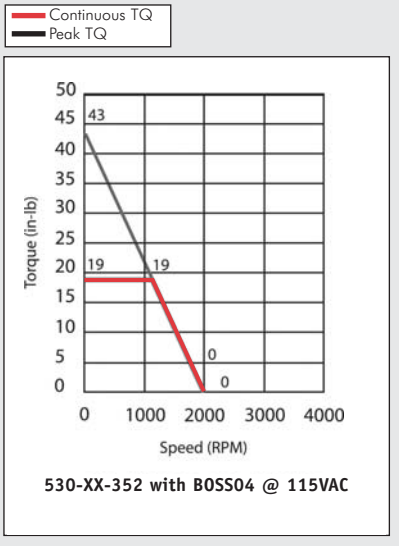
**Cogging may also occur at speeds less than 300 RPM**



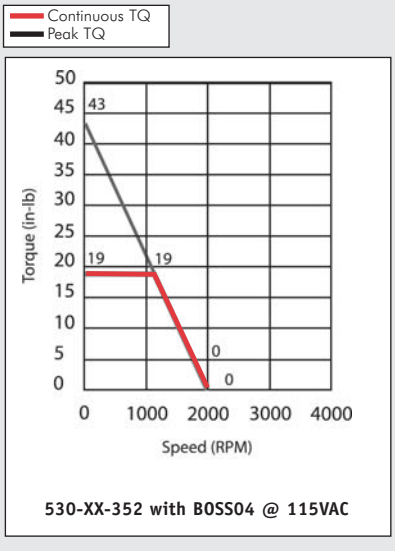

**530-XX-334 with BOSS04 @ 115VAC**



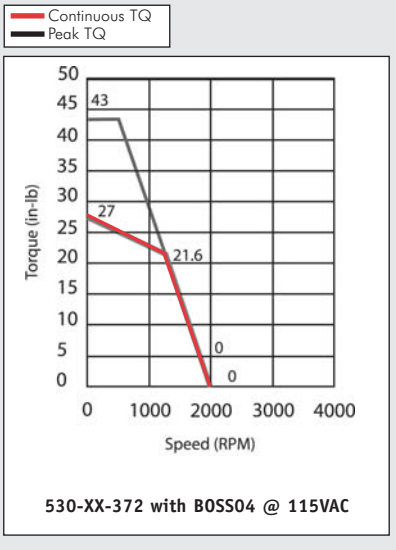

**530-XX-334 with BOSS04 @ 230VAC**



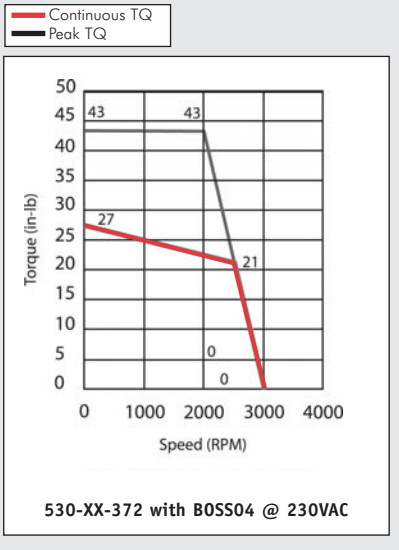

**530-XX-352 with BOSS04 @ 115VAC**



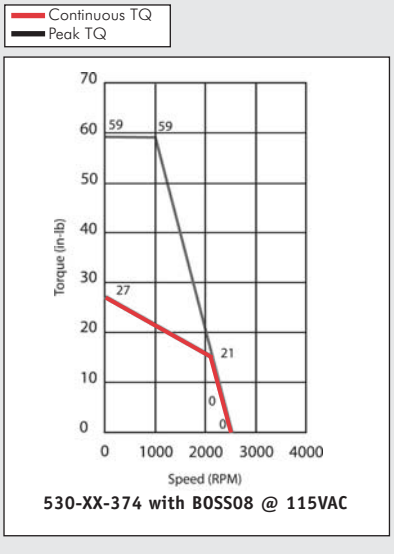

**530-XX-352 with BOSS04 @ 115VAC**



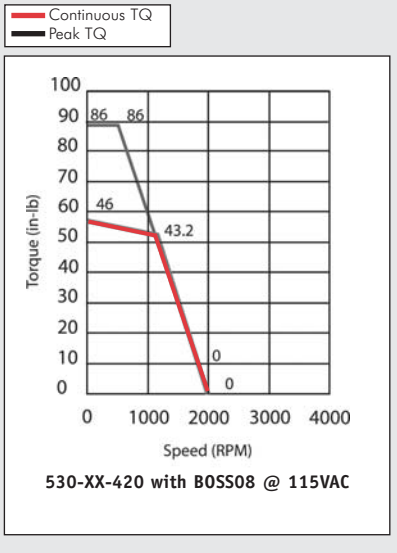

**530-XX-372 with BOSS04 @ 115VAC**



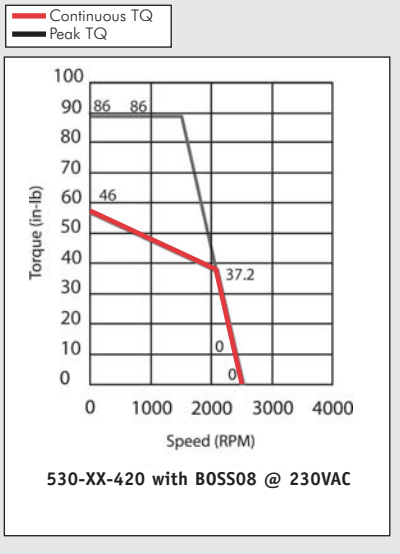

**530-XX-372 with BOSS04 @ 230VAC**




**530-XX-374 with BOSS08 @ 115VAC**




**530-XX-420 with BOSS08 @ 115VAC**



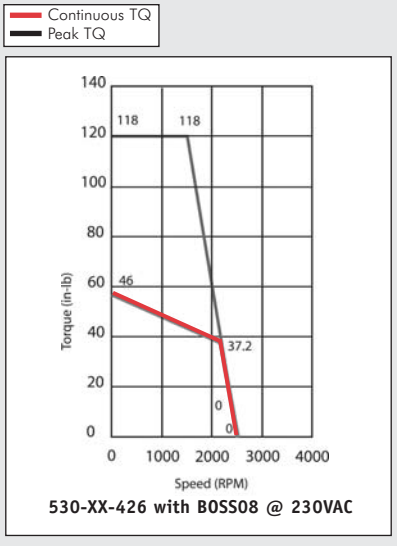

**530-XX-420 with BOSS08 @ 230VAC**

# Speed Torque Curves

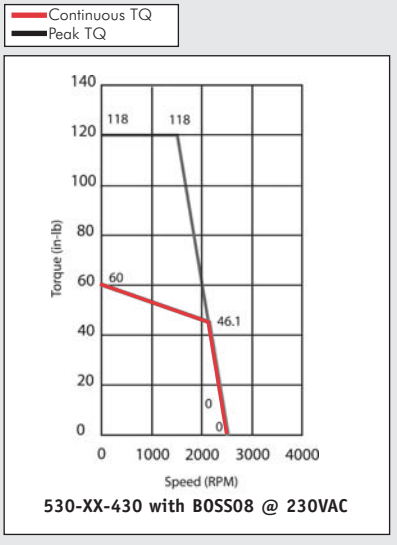


**Torque loss or torque rippling may occur when running in velocity mode at speeds under 300 RPM.**

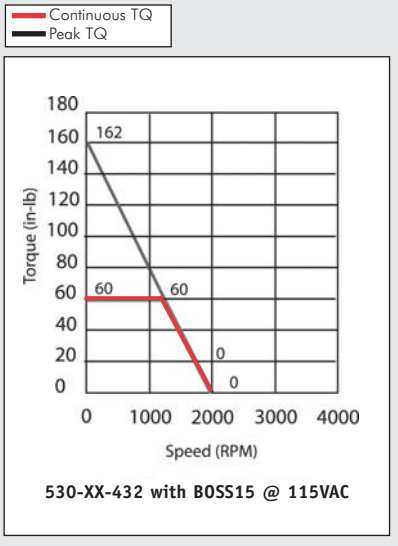
**Cogging may also occur at speeds less than 300 RPM**



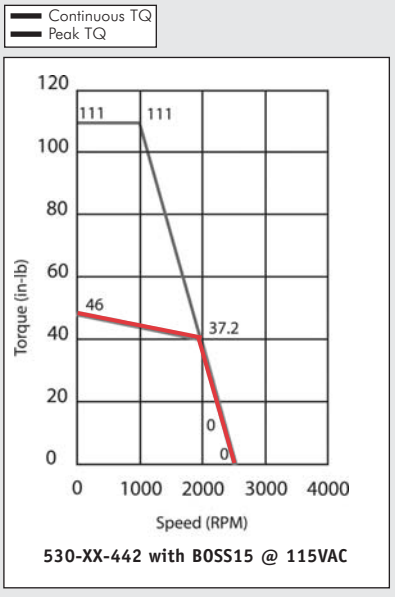

**530-XX-426 with BOSS08 @ 230VAC**




**530-XX-430 with BOSS08 @ 230VAC**




**530-XX-432 with BOSS15 @ 115VAC**




**530-XX-442 with BOSS15 @ 115VAC**



Minarik DRIVES Call us toll free 1•800•MINARIK or download manuals at www.minarikdrives.com

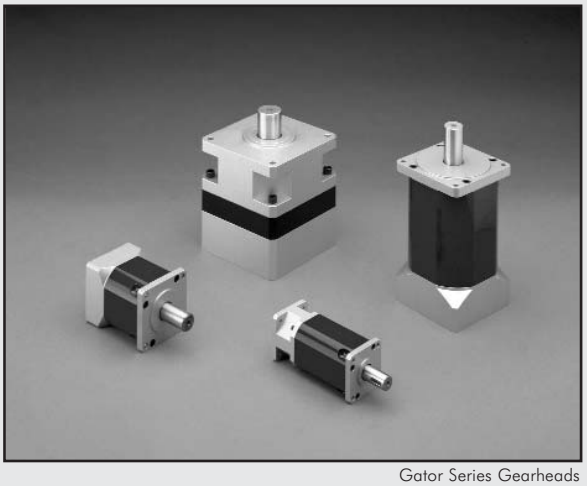
# Minarik's Gator Series Gearheads

Today's high energy motors can produce large torques while operating at high speeds. At times, this can put a mechanical strain or create resolution problems on all the devices that are trying to utilize this power. Minarik's Gator Series Gearheads are the solutions to link your motor to these demanding applications. This true planetary gearhead can reduce your speed while multiplying the torque output to properly harness all of your motor's power.

Planetary gearheads take the speed and torque developed at the motor's output shaft pinion (sun gear) and effectively divides it into three orbiting planetary gears. These planet gears react off of two different gear engagements; the rotating sun gear on one side and the stationary ring gear that surrounds the entire assembly on the other side. The number of teeth on the sun, planet, and ring gears determine the ratio of how much the speed will be reduced and how much gain will result in output torque.

The ring gear engagement forces the planet gears to rotate in relative motion to the sun gear. This power, which had earlier been dispersed to three planet gears, is now collectively harnessed back through the planet gear bearing journals into a carrier plate which in turn drives a subsequent stage or your output shaft. Although it may sound simple in theory, the details of proper design segregate one manufacturer from another.

Most planetary gearheads take advantage of the gear load sharing nature inherent in a planetary design which reduces concentrated tooth loading and maximizes torque capabilities. They symmetrically balance all gear engagements so no radial loading results. Low backlash and high efficiency are also common characteristics of this design. The advantages of Minarik's Gator Series planetary gearheads goes beyond these common characteristics.



Gator Series Gearheads

Here are a few common features that Minarik provides standard:

- Thru hardened 17-4 Stainless Steel Output shafts
- Oversized sealed bearings for large radial loads
- Hard Anodized mounting brackets and powdered coated body
- O-Ring gasketed assembly
- Input and output shaft seals
- Precision cut AGMA 10 gears (minimum)
- Double clamping Integrated pinion gear providing the highest strength and accuracy available
- Easy mounting to the BLDC motors and all Nema Standard interfaces
- High efficiency and low backlash
- Semi-grease for quiet operation and better lubrication (No-grease slinging)
- Stainless Steel hardened alloy gears and carrier plates
- Precision ground planet gear journals and needle bearing support
- IP65 rating

All of our gearheads have been tested to verify the superior ratings the Gator Series Gearheads produce. Our advantages stem from engineering expertise in material selection, precision machine quality, service, and cost. We do not believe you can find a better planetary gearhead on the market today. Compare the backlash, torque, and speed ratings between our planetary and any competitor, then call us for pricing and delivery. When you make these fair comparisons, you'll find that Minarik Gator Series Gearheads produce an unfair advantage.

# Gator Series

**WEIGHT**
Ratios 4:1 to 10:1= 1.1 lbs
Ratios 16:1 to 100:1= 1.76 lbs
**INPUT RPM RANGE**
0 to 5000 RPM
**TEMPERATURE RANGE**
-20 to 250 F°
**PEAK TORQUE**
15% above continuous rating

**BACKLASH**
Ratios 4:1 to 10:1
Standard = 6 arc-minutes
Low backlash unit = 3 arc-minutes (add -L to part #)
Ratios 16:1 to 100:1
Standard = 10 arc-minutes
Low backlash unit = 7 arc-minutes (add -L to part #)

## 17 Gator Planetary Gearheads

| Part Number | Ratio | Cont. output torque @ 1500 RPM input (in-lbs) | Cont. output torque @ 3500 RPM input (in-lbs) | Cont. output torque @ 5000 RPM input (in-lbs) | Gearhead inertia at input (lb-in-sec$^2$) |
|---|---|---|---|---|---|
| 518-41-004 | 4:1 | 177 | 136 | 116 | $1.60 \times 10^{-5}$ |
| 518-41-005 | 5.5:1 | 157 | 129 | 113 | $1.10 \times 10^{-5}$ |
| 518-41-007 | 7:1 | 143 | 122 | 110 | $9.56 \times 10^{-6}$ |
| 518-41-010 | 10:1 | 113 | 101 | 93 | $8.36 \times 10^{-6}$ |
| 518-41-016 | 16:1 | 211 | 194 | 182 | $1.59 \times 10^{-5}$ |
| 518-41-028 | 28:1 | 218 | 207 | 199 | $9.54 \times 10^{-6}$ |
| 518-41-040 | 40:1 | 212 | 212 | 207 | $8.35 \times 10^{-6}$ |
| 518-41-049 | 49:1 | 158 | 154 | 152 | $9.44 \times 10^{-6}$ |
| 518-41-070 | 70:1 | 160 | 156 | 154 | $8.30 \times 10^{-6}$ |
| 518-41-100 | 100:1 | 122 | 120 | 119 | $8.29 \times 10^{-6}$ |

Note: Repeated peak torque loading may cause failure. See page 86 for dimensional drawings.

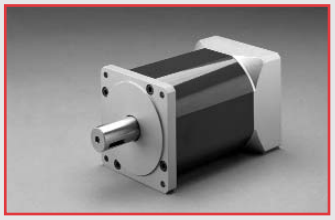
**WEIGHT**
Ratios 4:1 to 10:1= 2.2 lbs
Ratios 16:1 to 100:1= 3.63 lbs
**INPUT RPM RANGE**
0 to 5000 RPM
**TEMPERATURE RANGE**
-20 to 250 F°
**PEAK TORQUE**
15% above continuous rating

**BACKLASH**
Ratios 4:1 to 10:1
Standard = 6 arc-minutes
Low backlash unit = 3 arc-minutes (add -L to part #)
Ratios 16:1 to 100:1
Standard = 10 arc-minutes
Low backlash unit = 7 arc-minutes (add -L to part #)

## 23 Gator Planetary Gearheads

| Part Number | Ratio | Cont. output torque @ 1500 RPM input (in-lbs) | Cont. output torque @ 3500 RPM input (in-lbs) | Cont. output torque @ 5000 RPM input (in-lbs) | Gearhead inertia at input (lb-in-sec$^2$) |
|---|---|---|---|---|---|
| 518-42-004 | 4:1 | 410 | 294 | 242 | $5.24 \times 10^{-5}$ |
| 518-42-005 | 5.5:1 | 373 | 288 | 247 | $2.65 \times 10^{-5}$ |
| 518-42-007 | 7:1 | 344 | 279 | 245 | $1.93 \times 10^{-5}$ |
| 518-42-010 | 10:1 | 277 | 238 | 215 | $1.35 \times 10^{-5}$ |
| 518-42-016 | 16:1 | 521 | 463 | 427 | $5.32 \times 10^{-5}$ |
| 518-42-028 | 28:1 | 545 | 506 | 481 | $1.96 \times 10^{-5}$ |
| 518-42-040 | 40:1 | 553 | 525 | 506 | $1.36 \times 10^{-5}$ |
| 518-42-049 | 49:1 | 400 | 385 | 375 | $1.90 \times 10^{-5}$ |
| 518-42-070 | 70:1 | 404 | 393 | 385 | $1.33 \times 10^{-5}$ |
| 518-42-100 | 100:1 | 308 | 303 | 298 | $1.33 \times 10^{-5}$ |

Note: Repeated peak torque loading may cause failure. See page 86 for dimensional drawings.



**WEIGHT**
Ratios 4:1 to 10:1= 5.94 lbs
Ratios 16:1 to 100:1= 9.68 lbs

**INPUT RPM RANGE**
0 to 5000 RPM

**TEMPERATURE RANGE**
-20 to 250 F°

**PEAK TORQUE**
15% above continuous rating

**BACKLASH**
Ratios 4:1 to 10:1
Standard = 6 arc-minutes
Low backlash unit = 3 arc-minutes (add -L to part #)
Ratios 16:1 to 100:1
Standard = 10 arc-minutes
Low backlash unit = 7 arc-minutes (add -L to part #)

## 34 Gator Planetary Gearheads

| Part Number | Ratio | Cont. output torque @ 1500 RPM input (in-lbs) | Cont. output torque @ 3500 RPM input (in-lbs) | Cont. output torque @ 5000 RPM input (in-lbs) | Gearhead inertia at input (lb-in-sec$^2$) |
|---|---|---|---|---|---|
| 518-43-004 | 4:1 | 972 | 643 | 513 | $2.77 \times 10^{-4}$ |
| 518-43-005 | 5.5:1 | 913 | 657 | 543 | $1.51 \times 10^{-4}$ |
| 518-43-007 | 7:1 | 859 | 653 | 554 | $1.11 \times 10^{-4}$ |
| 518-43-010 | 10:1 | 707 | 575 | 505 | $7.90 \times 10^{-5}$ |
| 518-43-016 | 16:1 | 1350 | 1145 | 1027 | $2.86 \times 10^{-4}$ |
| 518-43-028 | 28:1 | 1432 | 1293 | 1203 | $1.14 \times 10^{-4}$ |
| 518-43-040 | 40:1 | 1469 | 1362 | 1293 | $8.04 \times 10^{-5}$ |
| 518-43-049 | 49:1 | 1067 | 1010 | 971 | $1.11 \times 10^{-4}$ |
| 518-43-070 | 70:1 | 1081 | 1040 | 1010 | $7.90 \times 10^{-5}$ |
| 518-43-100 | 100:1 | 827 | 805 | 790 | $7.87 \times 10^{-5}$ |

Note: Repeated peak torque loading may cause failure. See page 86 for dimensional drawings.



# Gator Series

**WEIGHT**
Ratios 4:1 to 10:1= 10.3 lbs
Ratios 16:1 to 49:1= 16.8 lbs

**INPUT RPM RANGE**
0 to 5000 RPM

**TEMPERATURE RANGE**
-20 to 250 F°

**BACKLASH**
Ratios 4:1 to 10:1
Standard = 6 arc-minutes
Low backlash unit = 3 arc-minutes (add -L to part #)
Ratios 16:1 to 49:1
Standard = 10 arc-minutes
Low backlash unit = 7 arc-minutes (add -L to part #)

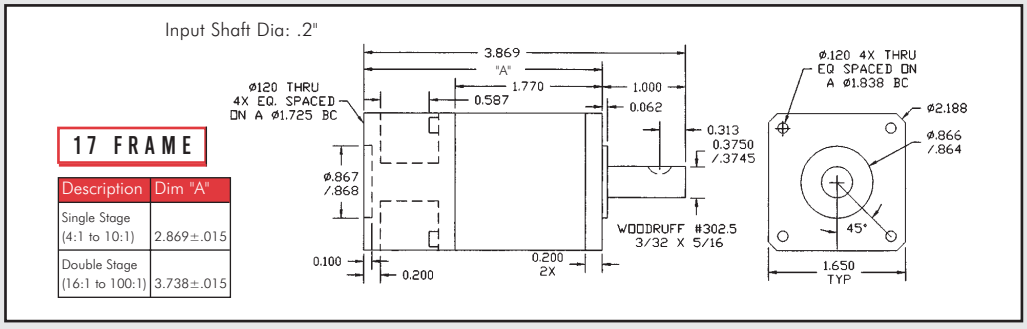
## 42 Gator Planetary Gearheads

| Part Number | Ratio | Cont. output torque @ 1500 RPM input (in-lbs) | Cont. output torque @ 3500 RPM input (in-lbs) | Cont. output torque @ 5000 RPM input (in-lbs) | Peak output torque (in-lbs) | Gearhead inertia at input (lb-in-sec$^2$) |
|---|---|---|---|---|---|---|
| 518-44-004 | 4:1 | 1993 | 1256 | 983 | 2491 | $1.02 \times 10^{-3}$ |
| 518-44-005 | 5.5:1 | 1913 | 1312 | 1062 | 2391 | $5.87 \times 10^{-4}$ |
| 518-44-007 | 7:1 | 1826 | 1327 | 1101 | 2283 | $4.56 \times 10^{-4}$ |
| 518-44-010 | 10:1 | 1527 | 1196 | 1029 | 1909 | $3.52 \times 10^{-4}$ |
| 518-44-016 | 16:1 | 3346 | 2745 | 2419 | 4183 | $1.05 \times 10^{-3}$ |
| 518-44-028 | 28:1 | 3599 | 3173 | 2913 | 4498 | $4.65 \times 10^{-4}$ |
| 518-44-040 | 40:1 | 3711 | 3383 | 3173 | 4639 | $3.57 \times 10^{-4}$ |
| 518-44-049 | 49:1 | 2710 | 2530 | 2411 | 3388 | $4.56 \times 10^{-4}$ |

Note: Peak torque listed for emergency situations. Repeated peak torque loading may cause failure. See page 86 for dimensional drawings.

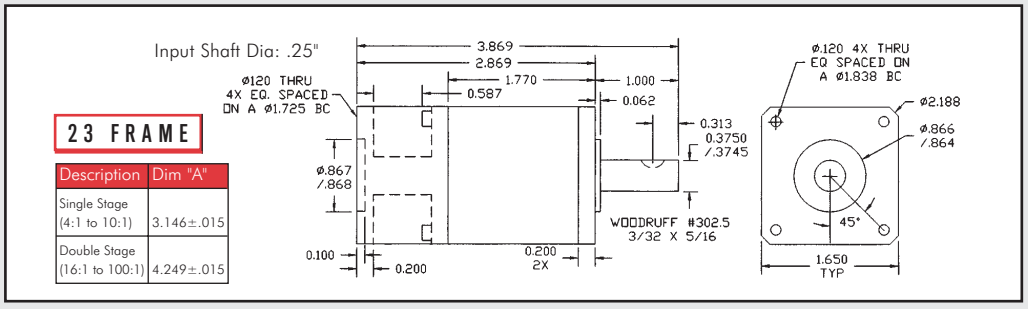
NEMA 56 Gator Series Planetary Gearheads also available in ratios 4, 5.5, 7, 10, 16, 28, 40 and 49:1. Please consult your Minarik representative for detailed information.

## 17 FRAME




| Description | Dim "A" |
|---|---|
| Single Stage (4:1 to 10:1) | 2.869±.015 |
| Double Stage (16:1 to 100:1) | 3.738±.015 |

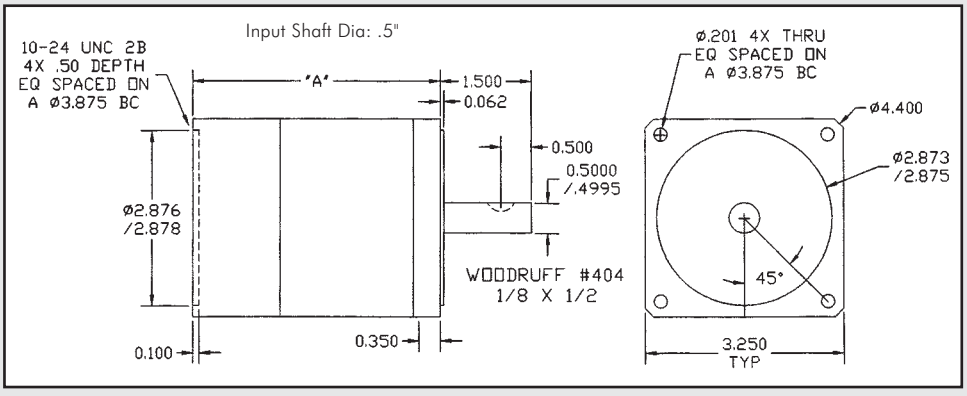
## 23 FRAME




| Description | Dim "A" |
|---|---|
| Single Stage (4:1 to 10:1) | 3.146±.015 |
| Double Stage (16:1 to 100:1) | 4.249±.015 |

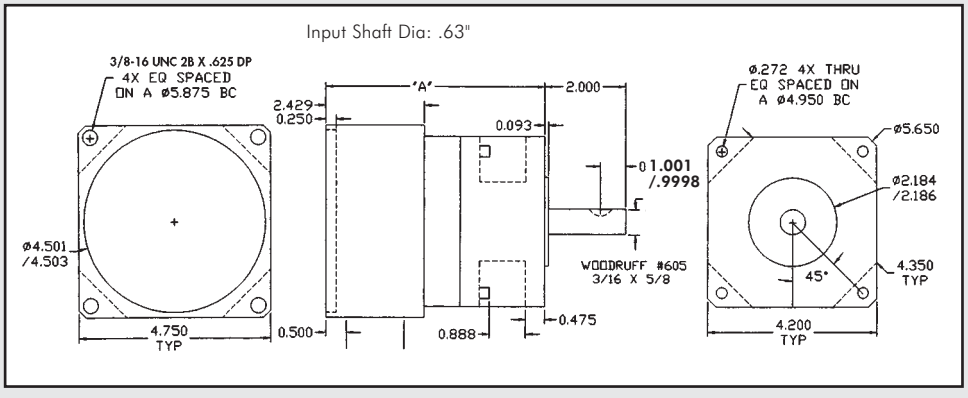
# Gator Series

## 34 FRAME




| Description | Dim "A" |
|---|---|
| Single Stage (4:1 to 10:1) | 4.063±.015 |
| Double Stage (16:1 to 100:1) | 5.431±.015 |

## 42 FRAME




| Description | Dim "A" |
|---|---|
| Single Stage (4:1 to 10:1) | 5.407±.015 |
| Double Stage (16:1 to 49:1) | 7.020±.015 |

- Custom mounting configurations available upon request.

## FEATURES & BENEFITS

- **Excellent Speed Regulation:** 0.05% speed regulation of set speed provides for tight control throughout a 200:1 speed range.
- **Pushbutton Programming:** Three front panel pushbuttons provide quick and easy programming.
- **4-Digit LED Display:** Red 0.5 inch (13 mm) wide digits for good visibility.
- **Programmable Decimal Point:** Makes specific application readouts easy.
- **Inhibit Terminal:** A low voltage, dry contact closure on the inhibit terminal will reduce the output to zero.
- **Selectable Feedback Devices:** Controls accept magnetic pickup, hall effect, inductive proximity sensor or encoder input.
- **+ 5 VDC or + 12 VDC (10 mA) Power Supply:** Provided to power feedback devices.

## DLC Series Specifications

| Model | AC Line Voltage | AC Line Power | Acceptable Feedback Sources | Analog Output Voltage Range | Power Supply Voltage for Feedback Devices | Speed Regulation | Feedback Frequency Range |
|---|---|---|---|---|---|---|---|
| DLC600 | •115 or 230 (VAC) ±10%<br>•50/60 HZ, Single phase | 5.5 watts nominally | •Hall Effect Sensor<br>•Electromagnetic Pickup<br>•5 or 12 VDC NPN-type encoder or proximity switch<br>•Encoder | 0 to +10 VDC | +5 VDC or +12 VDC @ 10 mA | 0.05% | 10 to 3000Hz* |

*System speed range may be limited by other factors, such as motor type, drive type, feedback resolution, etc.

# DLC Series

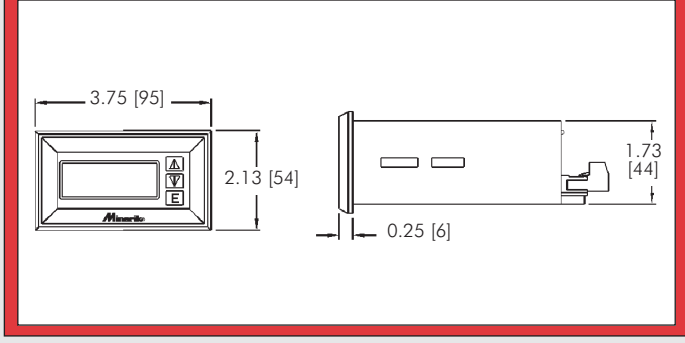
Minarik's DLC600 precisely controls your closed loop application speed. The DLC600's dual voltage capability allows it to replace Minarik's older DLC products. An encoder or proximity switch, hall effect sensor, or electromagnetic pickup can provide the necessary feedback. Any engineering units, from revolutions per minute, to widgets per day can be used to display and program the speed. The large 4-digit LED display allows you to easily see exactly what speed you are running. When it comes to low-cost closed loop control, the DLC600 is your solution.

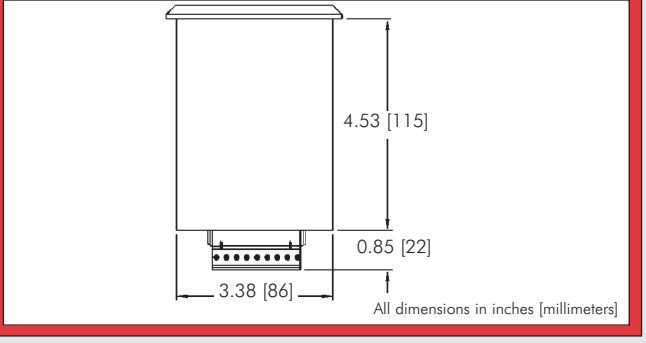
## Typical Applications

- Food Processing Equipment
- Material Handling Equipment
- Conveyors
- Winding Machinery
- Film Processors
- Extruders

DLC600

## DLC Dimensions




All dimensions in inches [millimeters]

## FEATURES & BENEFITS

- **Four Operating Modes:** Displays 1) speed of application or multiple of it 2) time in process indicating duration of application 3) the inverse speed (i.e., minutes per revolution) 4) number of counts received from feedback device.
- **Selectable Feedback Devices:** Accepts magnetic pickup, hall effect, inductive proximity sensor or encoder input.
- **+5 VDC (50mA) or +12 VDC (25mA) power supply:** Provided to power feedback device.
- **Wide Frequency Range:** Accepts 0 - 20,000 Hz from feedback device.
- **Easy to Read Display:** 4-digit LED display is 0.7" (17.5 mm).

### VT8 Series Specifications

| Models | AC Line Voltage | AC Line Power | Acceptable Feedback Sources | Feedback Frequency Range | Power Supply Voltage for Feedback Devices |
|---|---|---|---|---|---|
| VT8-D230AC | 115 VAC/ 230 VAC ±10%, 50/60 Hz | 5.5 watts nominally | •5 or 12 VDC NPN-type encoder or proximity switch<br>•Hall Effect Sensor<br>•Electromagnetic Pickup | 0 - 20,000 Hz | +5 VDC or +12 VDC |

# VT8 Series

VT8-D230AC

### Typical Applications

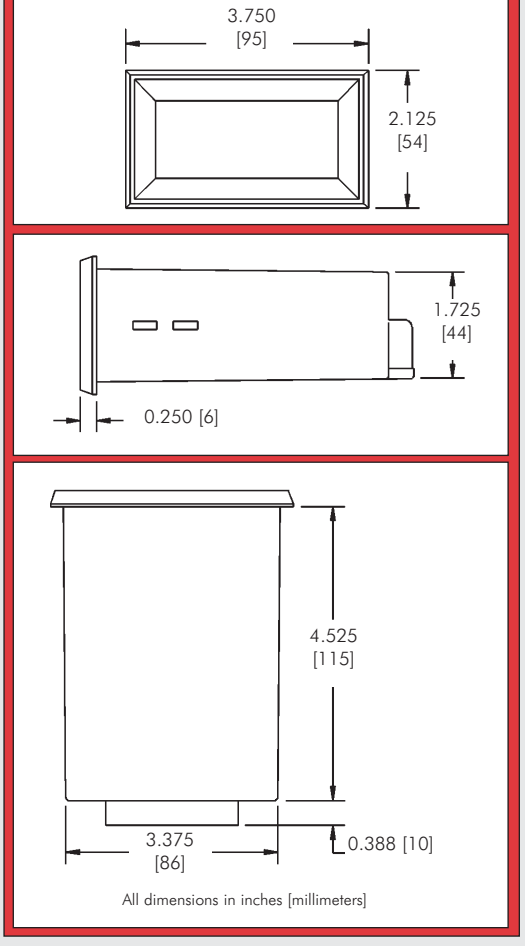
- Food Processing Equipment
- Material Handling Equipment
- Conveyors
- Winding Machinery
- Extruders

Minarik's VT8 Series is the choice when it comes to digital tachometers.

The VT8 Series provides a simple and accurate readout for any object that has an optical encoder, magnetic pickup, or anything else that can generate a frequency related to what you wish to measure.

There are four modes to choose from: tachometer mode for speed in any engineering unit, time in process for indicating the duration of an application, the inverse of speed (such as minutes per revolution), and basic totalizer for counting the frequency of the speed sensor.

### VT8 Dimensions




All dimensions in inches [millimeters]

## PK Series Specifications

**Electrical Input**

| | | | |
|---|---|---|---|
| Voltage | .5VDC | .12VDC | .15VDC |
| Current | .12 Milliamperes | .12 Milliamperes | .12 Milliamperes |
| Regulation | .±10%. | .±10%. | .±10% |

**Electrical Output** (All Models)

| | |
|---|---|
| Wave shape | .Square wave nominal |
| Rise Time | .Less than 10 Microseconds |
| Current | .Sink 0.8 Milliamperes @ 0.4 Volts (NPN) |
| Pulses per revolution. | .2 to 64 (specify) |

**Mechanical**

| | |
|---|---|
| Shaft speed | .20000 RPM maximum |
| Rotation | .Either direction |
| Hub bore | .0.187" PK24, 0.250" PK23 |
| Housing | .Delrin (black) |
| Cable | .3-conductor 24 AWG shielded (with drain) |
| Weight | .2 ounces |

The PK Series Encoder is available in several configurations as defined by its complete model number:

**PK2W - XX - YYV**

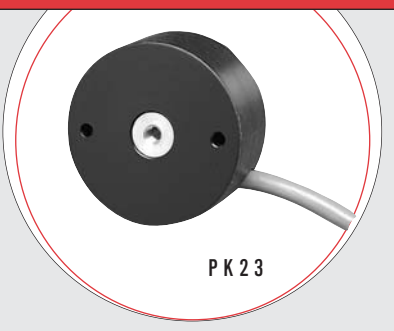
W = Series:
3 = Bodine style (1.812" mounting centers, #40-40 screw)
4 = Bison style (1.500" mounting centers, #6-32 screw)*

XX = Pulses Per Revolution (PPR): 2, 4, 8, 10, 30, 32, 60, 64
(Other choices may be available. Consult factory)

YY = Input voltage (volts DC): 5, 12, 15, 24
(Other voltages may by available. Consult Factory)

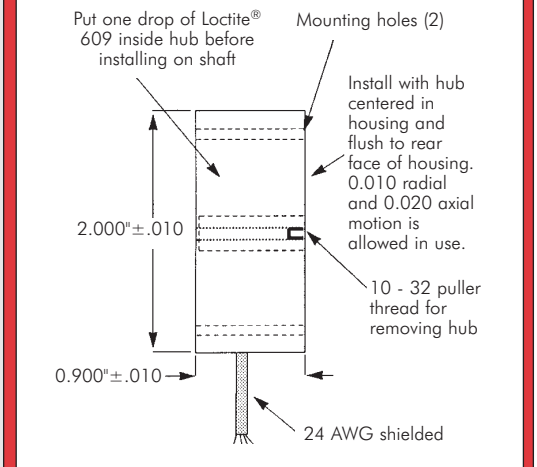
# PK Series

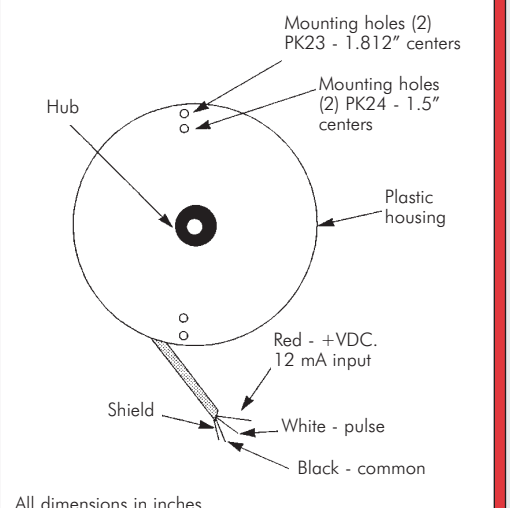
The PK23 and PK24 Series encoders are the newest additions to the Minarik encoder family. These encoders output a channel square wave to provide more accurate speed indication and regulation when used with digital accessories. Their hollow shaft design allows for easy installation without tedious alignment procedures. The accuracy and ease of installation make the PK23 and PK24 Series the ideal choice for your encoder feedback.



PK23

## PK Dimensions


Put one drop of Loctite® 609 inside hub before installing on shaft
Mounting holes (2)
Install with hub centered in housing and flush to rear face of housing. 0.010 radial and 0.020 axial motion is allowed in use.
2.000"±.010
10 - 32 puller thread for removing hub
0.900"±.010
24 AWG shielded

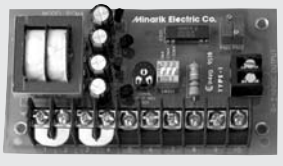



All dimensions in inches

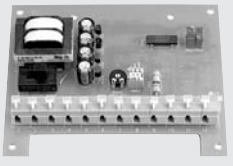
## Isolation Card (Open Chassis)

The PCM4 card is a compact and cost-effective solution for process control applications. Powered by 115 or 230 VAC, the PCM4 uses Burr Brown® Technology to isolate and condition incoming DC voltage signals from process controllers, motors, transducers, microprocessors or any signal. Typically, the output of the PCM4 connects to the input of a motor drive; hence, incompatible devices safely couple to yield a higher level of automation. Integrating this isolation card allows drives to follow any non-isolated external voltage or current analog process control signal.

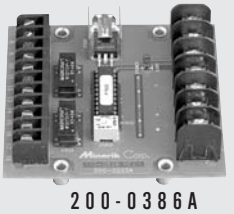
Dip-switch selectable, the PCM4 can follow any input voltage signal, grounded or ungrounded, from -250 to +250 VDC, and any input current signal from 1 to 50 mA. In response to the input, the PCM4 outputs an isolated bipolar signal from -12 to +12 VDC @ 10 mA, 0.01% linearity yields precise results. High resolution multi-turn pots lets users scale the output to within millivolts of the input or any desired proportion within the range of the output. Users may elect to control devices in manual mode using normal potentiometer operation rather than from an external signal input.



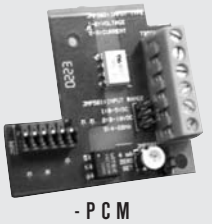

PCM4



Isolation Adder Board



200-0386A



-PCM

# Adder Boards

## Isolation Adder Board (Regenerative Drives Only)

Minarik regenerative drives increase their versatility and application capability when incorporating low-cost adder boards. Now as a standard product, users can retrofit isolation adder boards to the RG300UA, RG310UA, RG400UA, RG500UA, RG510UA, RGT300U, RGT310U, and RGT400U and thereby increase the automation capability of their system. After users mount the board to the drive, it can follow any external voltage or current signal; much like the PCM4. The added option increases the height dimension by 1.5 ", while all other parameters remain unchanged. In addition, the board has a direction input feature which can interpret a 0 to 10 VDC signal as a 0 to -10 VDC signal for bipolar operation from a unipolar signal input.

To obtain the isolation board for the RG500 Series, order 200-0416; RG400 and RGT400Series, specify 200-0417 and for the RG300 and RGT300 Series, order 200-0418.

## Pre-Mounted Isolation Board (-PCM suffix)

We also offer many drives with a pre-mounted isolation board attached by the factory. These drives are ordered with a -PCM suffix. Examples are MMXL-PCM, MAC05-D240AC-PCM, and VFD01-230AC-PCM. Other adder board options are available upon request, contact your local Minarik representative.

## Limit Switch Logic Board (Open Chassis)

Comparable to a mini-PLC, the 200-0386A logic board provides compact intelligence and a high degree of automation when combined with a regenerative drive in four-quadrant applications. Switching logic board modules interface regenerative variable-speed drives with pushbuttons, limit switches, foot switches, or programmable controls to produce a low-cost system. The logic module accepts commands from dry contact mechanical closures, current-sinking open-collectors, and TTL logic devices.

After wiring and selecting the dip-switch configuration, the 200-0386A operates in one of nine modes, including automatic cycling, single cycle, jog and more.

| STOCK NO. | DESCRIPTION | TECHNICAL DATA | MODEL USAGE |
|---|---|---|---|
| **Speed Dial and Knob** | | | |
| 110-0038 | Dial | 1.75" W X 1/5" w/0.375 hole | All chassis drives |
| 140-0009 | Knob | 4.40" X 3.00" X 0.70" aluminum | MM chassis controls |
| **Heat Sink** | | | |
| 223-0159 | Heat Sink | 4.40" X 3.00" X 0.70" aluminum | MM chassis controls |
| 223-0174 | Heat Sink | 7.78" X 6.00" X 0.89" aluminum | NEMA 1 cased controls |
| 223-0235 | Heat Sink | 9.20" X 6.90" X 1.00" aluminum | RG chassis controls |
| 223-0269 | Heatsink | 6.90" X 5.25" X 1.00" aluminum | MAC controls |
| 223-0271 | Heat Sink | 9.78" X 6.90" X 1.00" aluminum | XL controls |
| **Encoder/Feedback Devices** | | | |
| 200-0364 | Hall Effect | Sensor Assembly | Model PK17 |
| 211-0001 | Magnetic Pickup | Sensor | Models PK1, PK14A |
| 211-0006 | Magnetic Pickup | Sensor | Models PK3, PK4 |
| 211-0010 | Magnetic Wheel | 30 PPR | PK1 |
| 211-0038 | Magnetic Wheel | 60 PPR | PK17 |
| **Line Fuses** | | | |
| 050-0018 | AC Line Fuse | 15 Amp-3AB-Normal-Blow | All MM controls |
| 050-0019 | AC Line Fuse | 20 Amp-3AB-Normal-Blow | NRG and RG controls |
| 050-0021 | AC Line Fuse | 3 Amp-3AG-Fast-Acting | MM and C1XP controls |
| 050-0024 | AC Line Fuse | 10 Amp-3AB-Normal-Blow | XL |
| 050-0026 | Field Supply Fuse | 1.5 Amp-3AG | RG's |
| 050-0074 | Pico Fuse | .63A Pico Fuse | CE rated controls |
| **Switches** | | | |
| 080-0009 | AC power, RUN/STOP/FWD/REV | 3A, 250 VAC DPDT | Filtered cased NEMA1 control |
| 080-0027 | RUN/BRAKE and FWD/REV | 10A, 250VAC DPDT | Non-filtered NEMA1 controls |
| 080-0030 | FWD/BRAKE/REV | 10A, 250VAC DPDT VDE approved | Cased regens |
| RR2KP-U-DC24V | General purpose relay | 10A, 24VDC DPDT | IDEC |
| SR3P-06 | Relay socket | Din rail mount | IDEC |
| SR3P-05C | Relay socket | Din rail mount, finger safe | IDEC |
| DT-2RV212-A7 | Limit switch | DPDT roller lever | Micro Switch |
| DT-2R-A7 | Limit switch | DPDT pin plunger | Micro Switch |
| **Transformer** | | | |
| 230-0110 | Transformer | 115 VAC in/24 VAC out | |
| **Inhibit Plug** | | | |
| 201-0024 | Inhibit plug | 18" | All chassis drives |
| 201-0079 | Inhibit plug | 36" | All chassis drives |
| **Serial Cable** | | | |
| 134-0046 | Serial cable | DB9 male to female | DC5004Q |

# Accessories

| STOCK NO. | DESCRIPTION | TECHNICAL DATA | MODEL USAGE |
|---|---|---|---|
| **Brake Resistors*** | | | |
| 032-0020 | Brake Resistor | 10Ω 5W (fast braking) | MM and XL 1/3 to 1/2 Hp |
| 032-0033 | Brake Resistor | 1Ω 7W (medium braking) | MM and XL 1/20 to 1/4 Hp |
| 032-0043 | Brake Resistor | 25Ω 10W (slow braking) | MM and XL 1Hp and less |
| 032-0060 | Brake Resistor | 10Ω 40W (fast braking) | MM and XL 1Hp and less |
| 032-0062 | Brake Resistor | 20Ω 40W (fast braking) | MM and XL 2 Hp and less |
| 032-0076 | Brake Resistor | 40Ω 40W (medium braking) | MM and XL 2 Hp and less |
| 035-0006 | Brackets, 2 required | Mounting horizontally (flat) | 032-0060, 032-0062 |
| 035-0007 | Left-side bracket | Mounting vertically (like inside of panel) | 032-0060, 032-0062 |
| 035-0008 | Right-side bracket | Mounting vertically (like inside of panel) | 032-0060, 032-0062 |
| BOSSDB-115 | BOSS-4Q Regen Circuit | Regen Circuit; 3.64" X 4.30" X 1.62" | BOSS-4Q with 115 VAC |
| BOSSDB-230 | BOSS-4Q Regen Circuit | Regen Circuit; 3.64" X 4.30" X 1.62" | BOSS-4Q with 230 VAC |
| **Kits & Covers** | | | |
| 155-0074 | Clear NEMA4 cover | Polysilicone | DLC300/400/500 |
| 155-0075 | Clear NEMA4 cover | Polysilicone | VT6-115/230/VT7 |
| 210-0191 | Bezel and lens | Polycarbonate, red | DLC600 |
| 202-0014 | Mounting kit | 2 brackets, 4 screws | DLC600, VT8-D230AC |
| 220-0048 | Bezel and lens | Polycarbonate, red | VT8-115/230 |
| 220-0049 | Blank bezel and lens | Polycarbonate, red | VT8-115/230 |
| 220-0051 | Bezel and lens | Polycarbonate, red | DLC300/400 |
| 221-0042 | Mounting Bracket | 2 required per model | DLC100/DLC200 |
| **EMI/RFI Line Filters** | | | |
| 6EP1 | Reduces control noise | Meets VDE-A, FCC-B | XL3025, BOSS-4Q |
| 6VDK1 | Reduces control noise | Meets FCC-A, FCC-B, VDE-A | MM's and RG's to 1/4 Hp |
| 6VSK1 | Reduces control noise | Meets FCC-A | XL3025, BOSS-4Q |
| 6VV1 | Reduces incoming noise | Meets EN55011, EN50082-1, EN60204-1 | MM and PCM to 1/4 Hp |
| 10EP1 | Reduces control noise | Meets FCC-A | XLs to 1 Hp, BOSS-4Q |
| 15ET1 | Reduces control noise | Meets FCC-A, FCC-B | XLs to 2 Hp, BOSS-4Q |
| 20VDK1 | Reduces control noise | Meets FCC-A, FCC-B, VDE-A | MM's and RG's 1/4 Hp and up |
| 20VV1 | Reduces incoming noise | Meets EN55011, EN50082-1, EN60204-1 | MM and PCM 1/4 Hp and up |
| 5VR1 | Reduces incoming noise | Meets EN55011, EN50082-1, EN60204-1 | MMRG, RG and RGT up to 1/4 Hp |
| 20VR1 | Reduces incoming noise | Meets EN55011, EN50082-1, EN60204-1 | MMRG, RG and RGT 1/4 Hp and up |
| **CE Filters** | | | |
| CE4MM | Reduces control noise | Meets EN55011, EN50082-1, EN60204-1 | 4 Amp, DC output CE filters for MM Series |
| CE20MM | Reduces control noise | Meets EN55011, EN50082-1, EN60204-1 | 20 Amp, DC output CE filters for MM Series |
| CE4RG | Reduces control noise | Meets EN55011, EN50082-1, EN60204-1 | 4 Amp, DC output CE filters for RG Series |
| CE20RG | Reduces control noise | Meets EN55011, EN50082-1, EN60204-1 | 20 Amp, DC output CE filters for RG Series |
| CE24PWM | Reduces incoming noise | Meets EN55011, EN50082-1, EN60204-1 | 24 Amp, AC input CE filters for PWM Series |
| CE04XL | Reduces incoming noise | Meets EN55014, EN50082-1, EN60204-1 | 4 Amp, AC input CE filters for XL Series |
| CE15XL | Reduces incoming noise | Meets EN55014, EN50082-1, EN60204-1 | 15 Amp, AC input CE filters for XL Series |
| CE20XL | Reduces incoming noise | Meets EN55014, EN50082-1, EN60204-1 | 20 Amp, AC input CE filters for XL Series |
| **Potentiometers** | | | |
| 202-0001 | Pot Kit | 1.5 kΩ | XL's with low voltage motors |
| 202-0003 | Pot Kit | 10 kΩ | Most Minarik Controls |
| 202-0005 | Pot Kit | 50 kΩ | RG25/51 Controls |
| 202-0056 | Pot Kit | 2.5 kΩ | XL's with low voltage motors |
| 202-0112 | Pot Kit | 10 kΩ | M2 Controls |

*If braking more frequently than once every 2 minutes, the 032-0060 and 032-0062 require two resistor brackets and double heat sinking.

| STOCK NO. | DESCRIPTION | TECHNICAL DATA | MODEL USAGE |
|---|---|---|---|
| **Dynamic Braking** | | | |
| 840-100 | Dynamic braking resistor module | 1/4 - 1/2 Hp, 208 to 230 VAC motor voltage | AC100 & 200 series |
| 840-101 | Dynamic braking resistor module | 1 - 1.5 Hp, 208 to 230 VAC motor voltage | AC100 & 200 series |
| 840-102 | Dynamic braking resistor module | 2 - 3 Hp, 208 to 230 VAC motor voltage | AC100 & 200 series |
| 840-103 | Dynamic braking resistor module | 5 Hp, 208 to 230 VAC motor voltage | AC200 series |
| 840-104 | Dynamic braking resistor module | 7.5 Hp, 208 to 230 VAC motor voltage | AC200 series |
| 840-105 | Dynamic braking resistor module | 10 Hp, 208 to 230 VAC motor voltage | AC100 & 200 series |
| 840-106 | Dynamic braking resistor module | 1/4 - 1/2 Hp, 400 to 480 VAC motor voltage | AC100 & 200 series |
| 840-107 | Dynamic braking resistor module | 1 - 1.5 Hp, 400 to 480 VAC motor voltage | AC100 & 200 series |
| 840-108 | Dynamic braking resistor module | 2 - 3 Hp, 400 to 480 VAC motor voltage | AC100 & 200 series |
| 840-109 | Dynamic braking resistor module | 5 Hp, 400 to 480 VAC motor voltage | AC200 series |
| 840-110 | Dynamic braking resistor module | 7.5 Hp, 400 to 480 VAC motor voltage | AC200 series |
| 840-111 | Dynamic braking resistor module | 10 Hp, 400 to 480 VAC motor voltage | AC100 & 200 series |
| 840-112 | Dynamic braking resistor module | 1 - 1.5 Hp, 480 to 590 VAC motor voltage | AC100 & 200 series |
| 840-113 | Dynamic braking resistor module | 2 - 3 Hp, 480 to 590 VAC motor voltage | AC100 & 200 series |
| 840-114 | Dynamic braking resistor module | 5 Hp, 480 to 590 VAC motor voltage | AC200 series |
| 840-115 | Dynamic braking resistor module | 7.5 Hp, 480 to 590 VAC motor voltage | AC200 series |
| 840-116 | Dynamic braking resistor module | 10 Hp, 480 to 590 VAC motor voltage | AC200 series |
| 840-117 | Dynamic braking module* | 15 - 25 Hp, 208 to 230 VAC motor voltage | AC200 series |
| 840-118 | Dynamic braking module* | 15 - 25 Hp, 400 to 480 VAC motor voltage | AC200 series |
| 840-119 | Dynamic braking module* | 15 - 25 Hp, 480 to 590 VAC motor voltage | AC200 series |
| 841-030** | Dynamic Braking Kit (field installation)* | 1/2-3Hp@200/240V, 1-3Hp@400/480V, & 1-5Hp@480/590V | AC300 & 400 series |
| 841-031** | Dynamic Braking Kit (field installation)* | 5Hp@200/240VAC and 5Hp@400/480VAC | AC300 & 400 series |
| 841-032** | Dynamic Braking & Form C Relay Kit* | 7.5-30Hp@200/240V, 10-60Hp@400/480V, & 10-60@480/590V | AC300 & 400 Series |
| 841-033** | Dynamic Braking & Form C Relay Kit* | 7.5Hp@400/480VAC & 7.5Hp@480/590VAC | AC300 & 400 series |
| 841-100 | Dynamic Braking Resistors | 1.5Hp@200/240VAC & 1Hp @480/590VAC | AC300 & 400 series |
| 841-101 | Dynamic Braking Resistors | 1-1.5Hp@200/240V, 1Hp @400/480V, & 2Hp @480/590V | AC300 & 400 series |
| 841-102 | Dynamic Braking Resistors | 2 Hp @200/240VAC & 2 Hp @400/480VAC | AC300 & 400 series |
| 841-103 | Dynamic Braking Resistors | 3 Hp @480/590VAC | AC300 & 400 series |
| 841-104 | Dynamic Braking Resistors | 3 Hp@200/240VAC, 3Hp@400/480VAC, & 5Hp@480/590VAC | AC300 & 400 series |
| 841-105 | Dynamic Braking Resistors | 5Hp @200/240VAC & 5Hp @400/480VAC | AC300 & 400 series |
| 841-106 | Dynamic Braking Resistors | 7.5-10Hp @200/240VAC & 7.5-10Hp @400/480VAC | AC300 & 400 series |
| 841-107 | Dynamic Braking Resistors | 7.5-10Hp @480/590VAC | AC300 & 400 series |
| 841-108 | Dynamic Braking Resistors | 15-20Hp @200/240VAC & 15-20Hp @400/480VAC | AC200,300, & 400 series |
| 841-109 | Dynamic Braking Resistors | 15-20Hp @480/590VAC | AC200, 300, & 400 series |
| 841-110 | Dynamic Braking Resistors | 25Hp @200/240VAC & 25-30Hp @400/480VAC | AC200, 300, & 400 series |
| 841-111 | Dynamic Braking Resistors | 25-30Hp @480/590VAC | AC200, 300, & 400 series |
| 841-112 | Dynamic Braking Resistors | 40Hp @400/480VAC | AC300 & 400 series |
| 841-113 | Dynamic Braking Resistors | 40Hp @480/590VAC | AC300 & 400 series |
| 841-114 | Dynamic Braking Resistors | 50-60Hp @400/480VAC | AC300 & 400 series |
| 841-115 | Dynamic Braking Resistors | 50-60Hp @480/590VAC | AC300 & 400 series |

*The "Dynamic Braking Resistors" listed above need to be ordered separately with these options
**It is recommended when ordering a new drive that these options be installed at the factory. Refer to the suffix information on the bottom of page 60 for ordering information.

| STOCK NO. | DESCRIPTION | TECHNICAL DATA | MODEL USAGE |
|---|---|---|---|
| **CE Filters** | | | |
| 844-400 | CE Filter | 10A, 1 Phase | AC100 & AC200 series |
| 844-401 | CE Filter | 20A, 1 Phase | AC100 & AC200 series |
| 844-402 | CE Filter | 8A, 3 Phase | AC100 & AC200 series |
| 844-403 | CE Filter | 10A, 3 Phase | AC100 & AC200 series |
| 844-404 | CE Filter | 20A, 3 Phase | AC100 & AC200 series |
| **Remote Keypad Options** | | | |
| 840-009 | Remote keypad w/ gasket | 8 foot connecting cable, NEMA 4X rated | AC100 series |
| 840-004 | Remote keypad w/ gasket | 8 foot connecting cable, NEMA 4X rated | AC200 series |
| 841-001 | Remote keypad ribbon cable | 2.5 feet | AC300 and AC400 series |
| 841-002 | Remote keypad ribbon cable | 5 feet | AC300 and AC400 series |
| 841-003 | Remote keypad ribbon cable | 10 feet | AC300 and AC400 series |
| 841-004** | Remote keypad kit (field installation) | 2.5 foot cable and NEMA 4 remote keypad | AC300 NEMA 1 models only |
| 841-005** | Remote keypad kit (field installation) | 5 foot cable and NEMA 4 remote keypad | AC300 NEMA 1 models only |
| 841-006** | Remote keypad kit (field installation) | 10 foot cable and NEMA 4 remote keypad | AC300 NEMA 1 models only |
| 841-007** | Remote keypad kit (field installation) | 2.5 foot cable and NEMA 4 remote keypad | AC400 NEMA 1 models only |
| 841-008** | Remote keypad kit (field installation) | 5 foot cable and NEMA 4 remote keypad | AC400 NEMA 1 models only |
| 841-009** | Remote keypad kit (field installation) | 10 foot cable and NEMA 4 remote keypad | AC400 NEMA 1 models only |
| **Relay Kits** | | | |
| 841-050** | Form C relay kit (field installation) | 1/4-5Hp @ all voltages | AC300 & 400 series |
| 841-051** | Form C relay kit (field installation) | 7.5-30Hp@200/240V, 10-60Hp@400/480V, & 10-60Hp@480/590VAC | AC300 & 400 series |
| 841-052** | Form C relay kit (field installation) | 7.5Hp@400/480VAC and 7.5Hp@480/590VAC | AC300 & 400 series |
| **Mounting Kits** | | | |
| 840-001 | "A" size din rail mounting kit | set of 6, 3.75" wide | AC100, 200 series & DB modules |
| 840-002 | "B" or "A" size din rail mounting kit | set of 6, 4.63" wide | AC100, 200 series & DB modules |
| 840-003 | "C" size din rail mounting kit | set of 6, 5.89" wide | AC100, 200 series & DB modules |
| "F" suffix | Through-hole mount option | allows drive heatsink to be mounted outside of enclosure, NEMA4X | AC200 series |
| **EPM Options** | | | |
| 840-005 | EPM programmer | 4.13H x 6.00W, battery operated | AC100 & 200 series |
| 840-006 | EPM modules bulk pack | 10 electronic programming modules | AC100 & 200 series |
| **High Frequency O** | | | |
| "V" suffix | High frequency output option | Up to 1000 Hz output to motor | AC100 & 200 series |

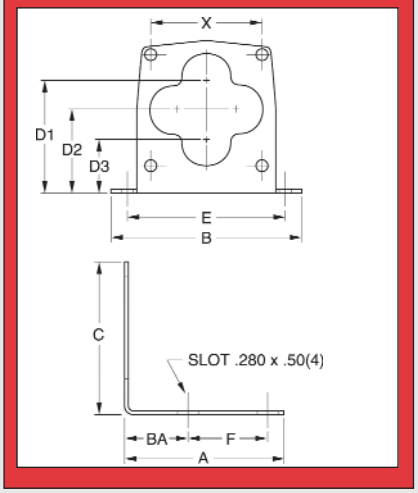
*The "Dynamic Braking Resistors" listed above need to be ordered separately with these options
**It is recommended when ordering a new drive that these options be installed at the factory.
Refer to the suffix information on the bottom of page 60 for ordering information.

## Sub-FHP Gearmotor "L" Mounting Bracket

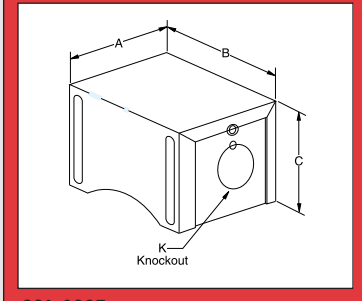
| Part Number | For Gearmotors | DIMENSIONS (Inches) A | B | C | D1 | D2 | D3 | X | BA | F | E |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 221-0991* | Z Series | 3.75 | 4.50 | 3.935 | 3.00 | 2.25 | 1.50 | 2.645 | 1.50 | 1.875 | 3.75 |
| 221-0992** | E Series | 4.50 | 6.00 | 5.520 | 4.00 | 3.10 | 2.20 | 3.625 | 1.50 | 2.500 | 5.00 |

* Maximum radial load no greater than 50 lbs.
** Maximum radial load no greater than 200 lbs.

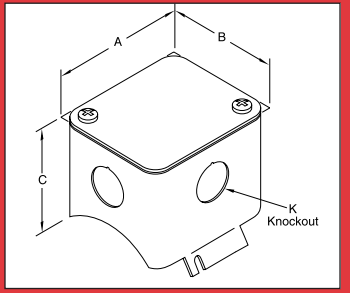
### Dimensions



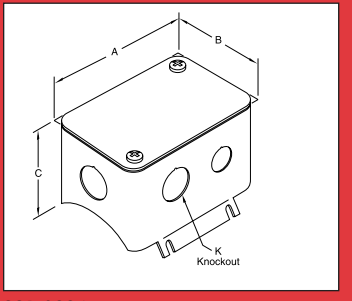

### Dimensions




221-0997




221-0993




221-0994

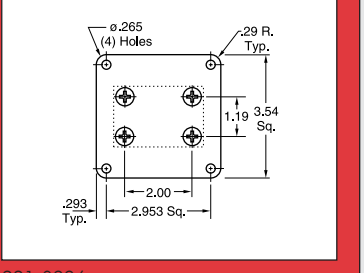
## Sub-FHP Gearmotor Conduit Boxes

| Part Number | For Frame Diameters | DIMENSIONS (Inches) A | B | C | K |
|---|---|---|---|---|---|
| 221-0997 | 2.38 | 2.09 | 2.45 | 2.23 | 0.875 |
| 221-0993 | 3.00 | 3.13 | 2.63 | 2.28 | 0.875 |
| | 3.07 | 3.13 | 2.63 | 2.28 | 0.875 |
| | 3.11 | 3.13 | 2.63 | 2.28 | 0.875 |
| | 3.38 | 3.13 | 2.63 | 2.28 | 0.875 |
| 221-0994 | 3.86 | 4.75 | 2.75 | 2.00 | 1.125 |

## Sub-FHP Gearmotor Right-Angle Base Kit

| Part Number |
|---|
| 221-0996 |

### Dimensions

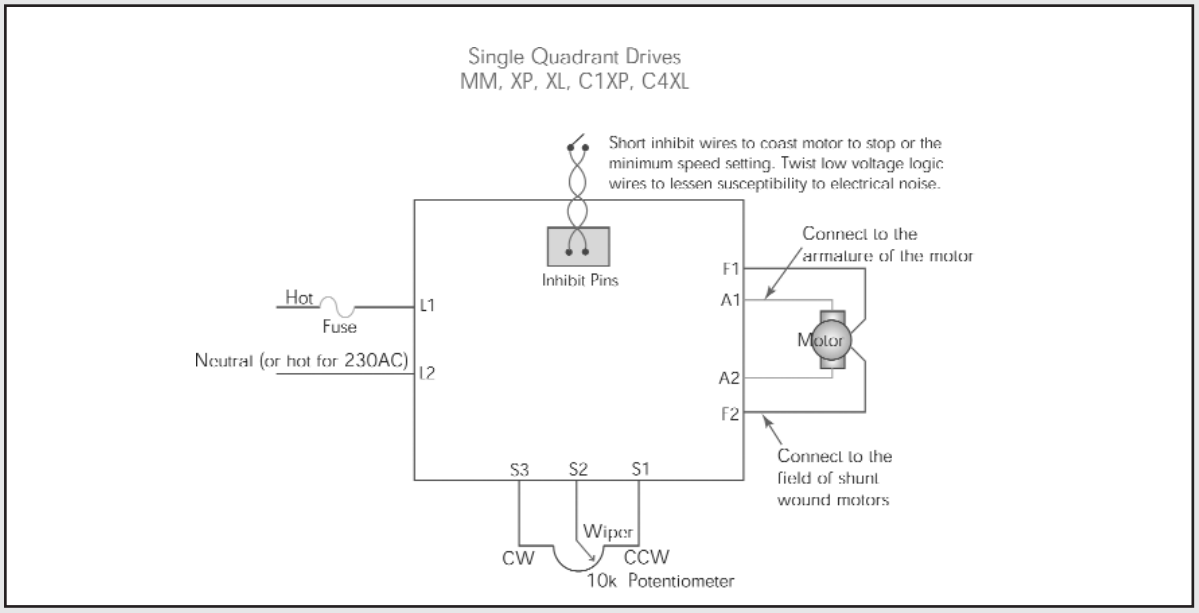



221-0996

# Wiring Diagrams

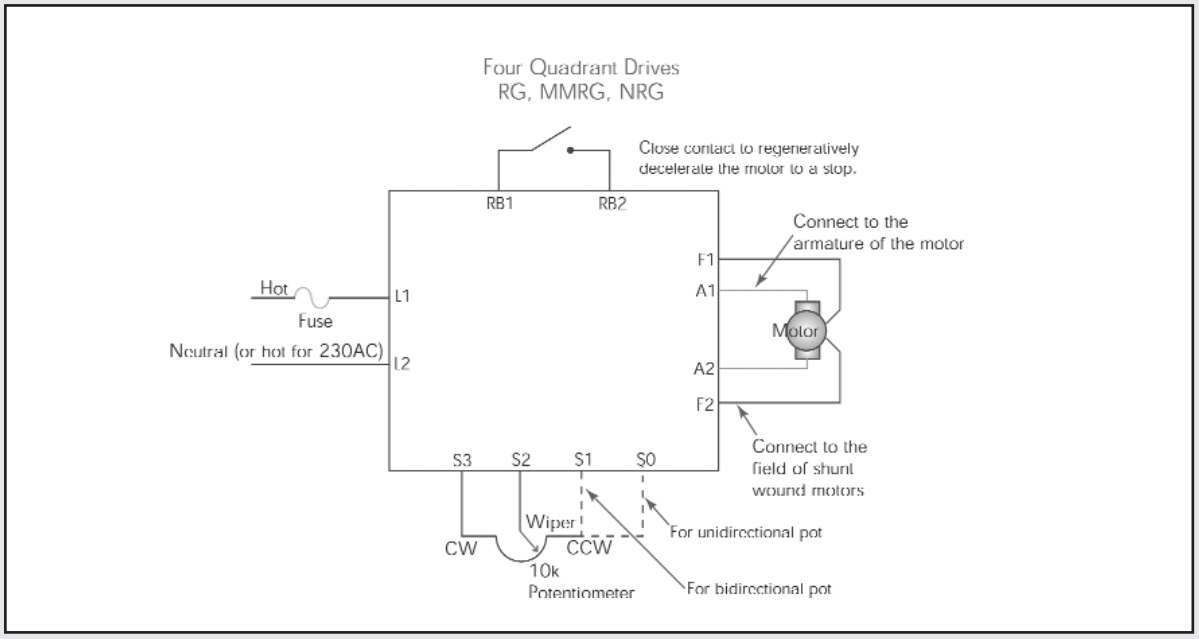
## SINGLE QUADRANT DRIVES

C1XP, C4XL, MM, MMXL, XP, XL



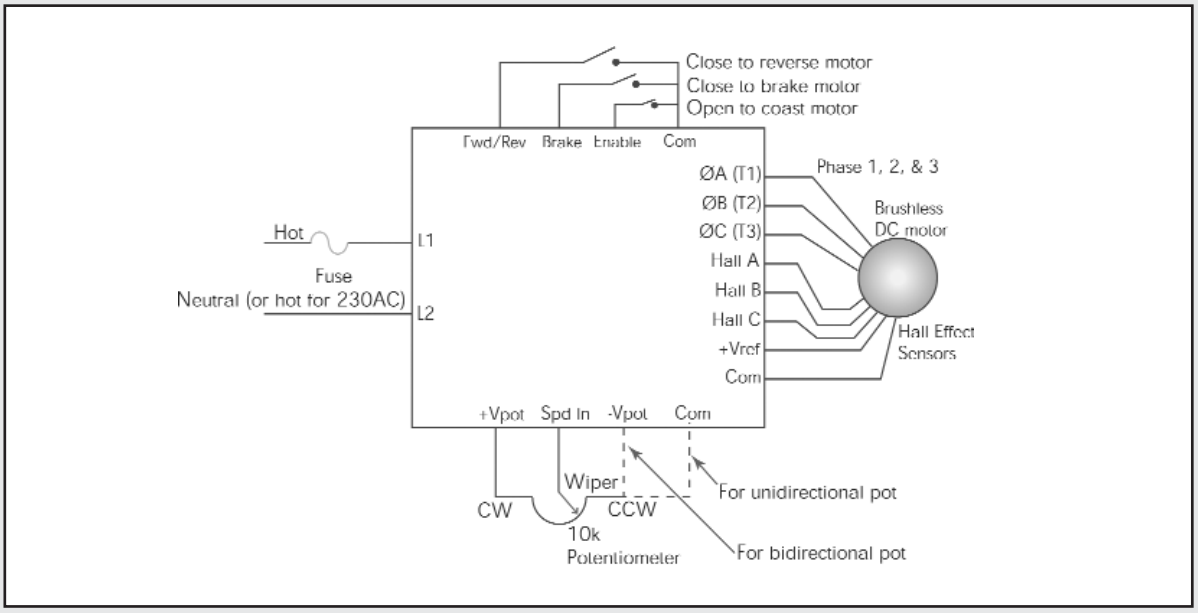

## FOUR QUADRANT DRIVES

C1RG,NRG, RG



## BRUSHLESS DRIVES

### BOSS 1Q, BOSS 4Q, LVBL

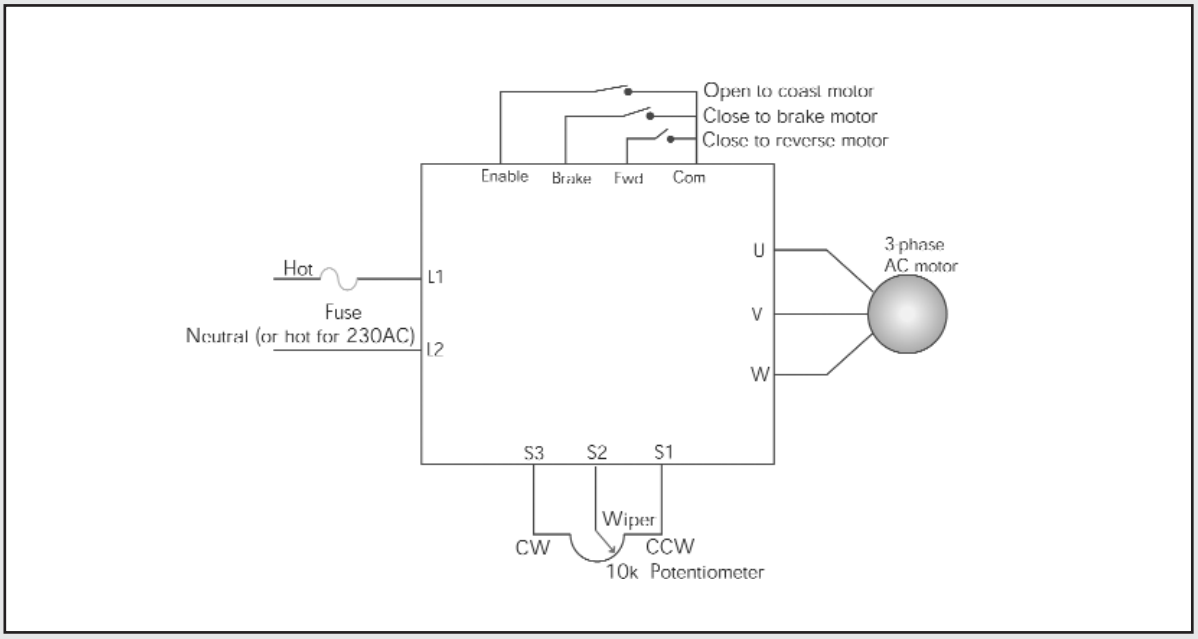





# Wiring Diagrams

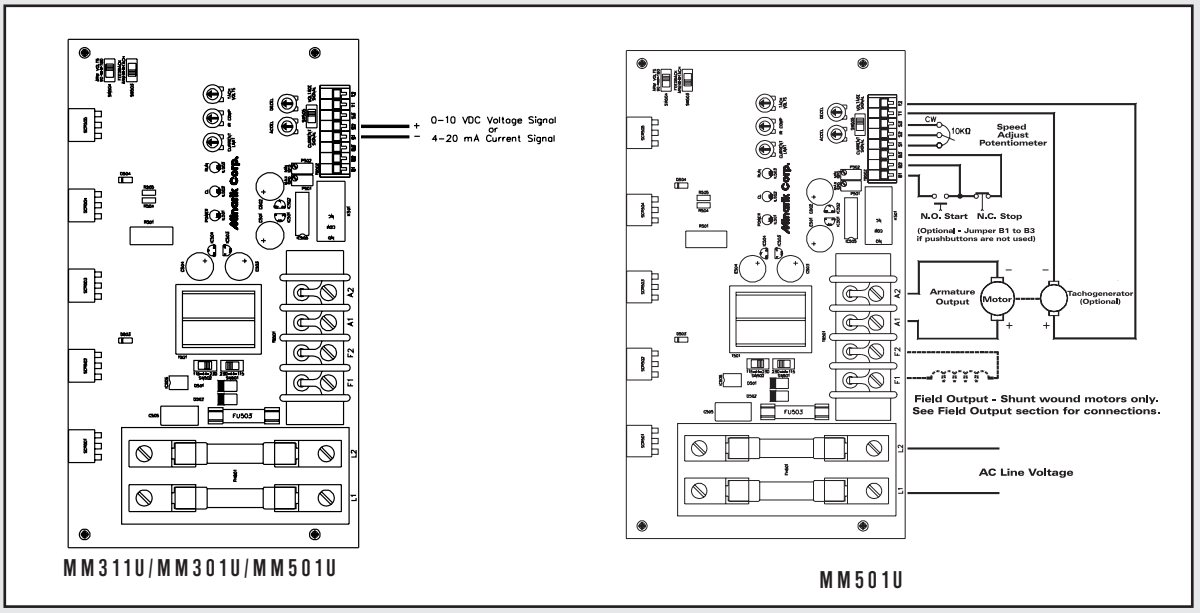
## 3-PHASE AC DRIVES

### MAC



# Wiring Diagrams

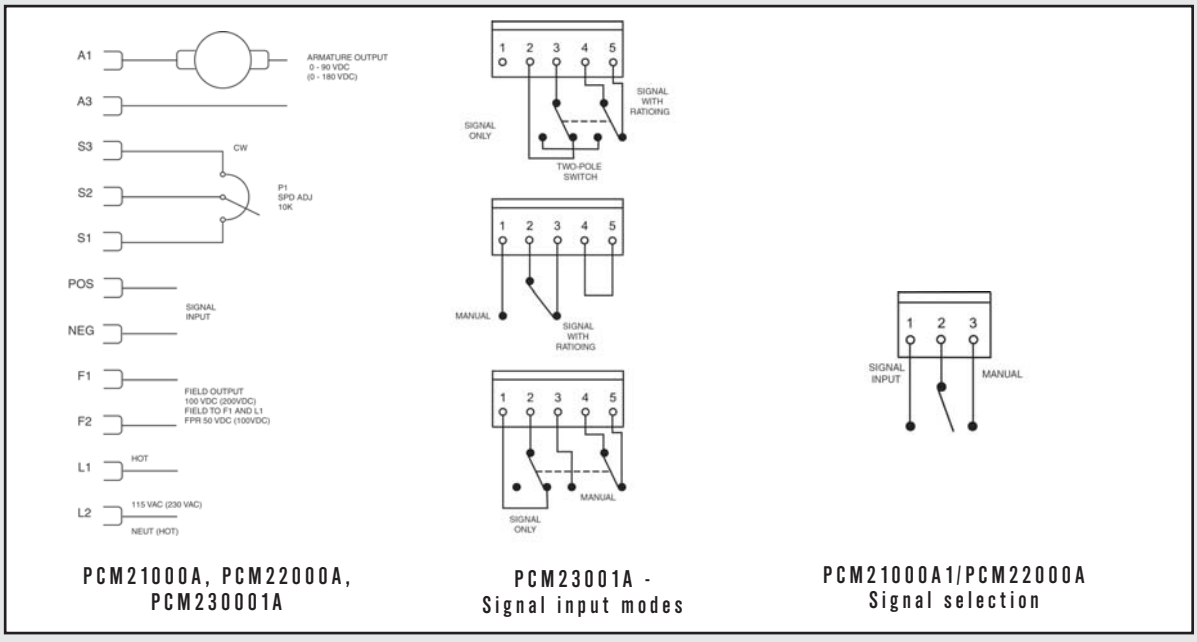
## SINGLE QUADRANT, ISOLATED DRIVES MM311U/MM301U/MM501U




MM311U/MM301U/MM501U

MM501U

## SINGLE QUADRANT, ISOLATED DRIVES PCM21000A, PCM220000A, PCM230001A



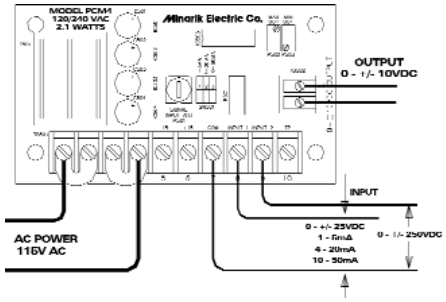

PCM21000A, PCM22000A, PCM230001A

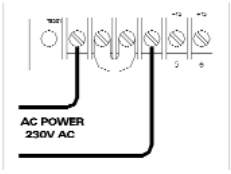
PCM23001A - Signal input modes

PCM21000A1/PCM22000A Signal selection

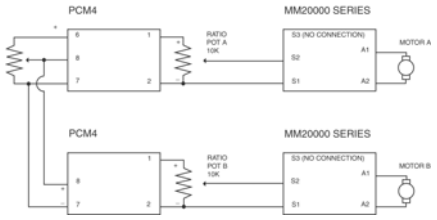
## ISOLATION DEVICES

### PCM4

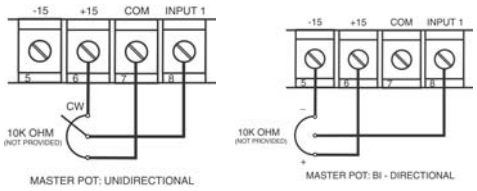



PCM4
Isolation module




PCM4
Speed ratio application




PCM4
Speed pot connection

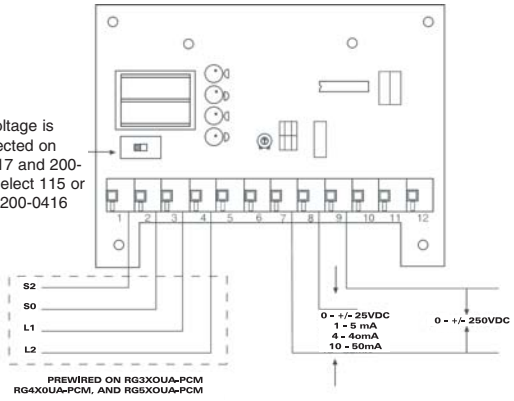


# Wiring Diagrams

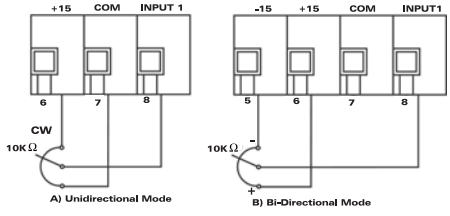
## ISOLATION CARDS

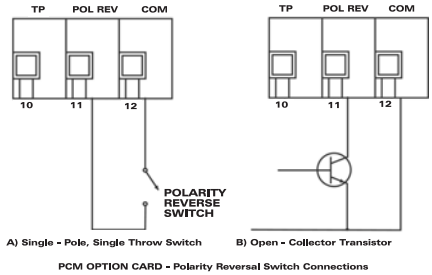
### PCM OPTION CARDS

Input voltage is pre-selected on 200-0417 and 200-0418. Select 115 or 230 on 200-0416




PCM Option Card
200-0416, 200-0417, 200-0418

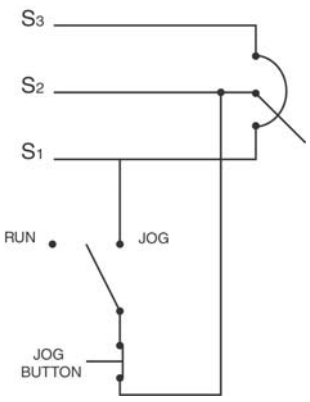



PCM Option Card
Polarity reversal switch connection

## JOG CIRCUIT

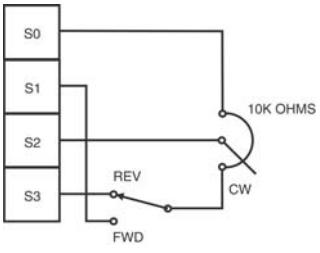
XL & MM CONTROLS



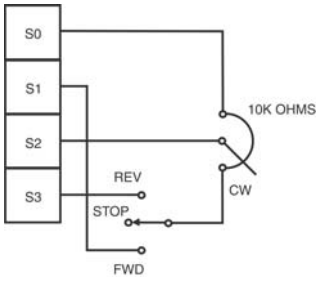
Jog circuit for any XL or MM control

# Wiring Diagrams

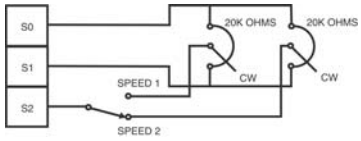
## RG SERIES



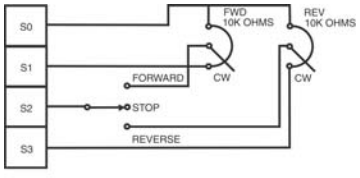

FORWARD-REVERSE SWITCH



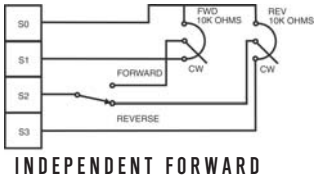

FWD-STOP-REV SWITCH




INDEPENDENT ADJUSTABLE SPEEDS



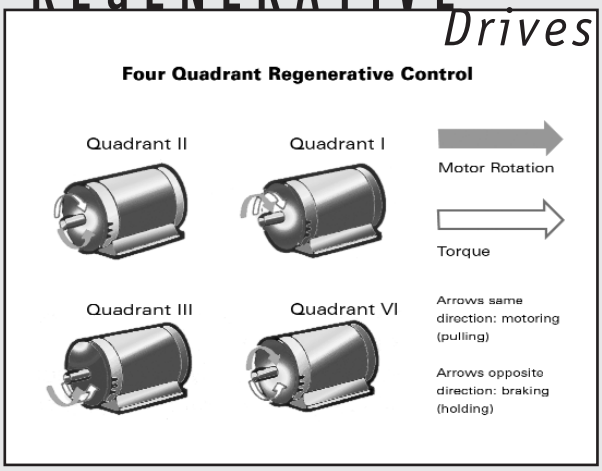

INDEPENDENT FORWARD & REVERSE SPEEDS WITH A FWD-STOP-REV SWITCH

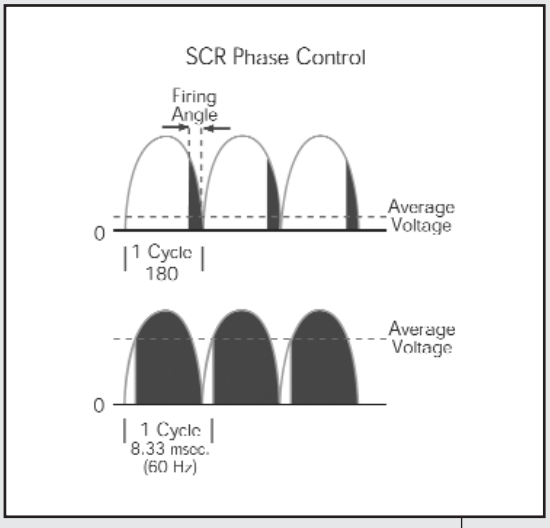



INDEPENDENT FORWARD SPEEDS

Regenerative drives have the ability to turn the mechanical energy required to brake a DC brushed motor back into electrical energy. They do this by electrically reversing or braking DC brushed motors at a user-defined rate. Therefore, there are no mechanical relays or resistors to wire or wear out. By being able to control torque in the opposite direction of speed, Regenerative drives can control overhauling loads caused by gravity or inertia. Minarik Regenerative drives run on either SCR or PWM technology, giving you more options to choose from. Any application that requires reversing, braking, or the control of overhauling loads should use a Regenerative drive.

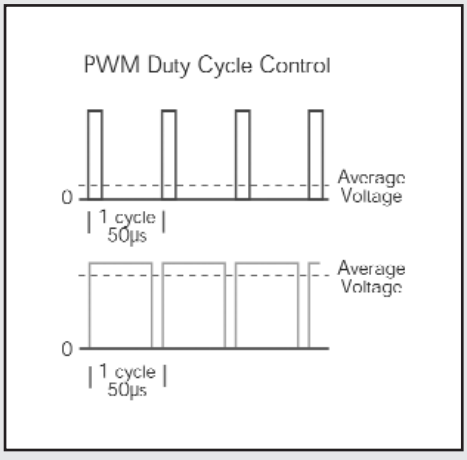
## REGENERATIVE *Drives*




## SCR *Drives*

Silicon Controlled Rectified (SCR) drives are excellent for your everyday DC brushed applications. They have been very popular for more than a decade and are low cost. Typically, SCR drives have 60:1 speed ranges and form factors of 1.37 at base. Applications involving variable speed in a single direction on an AC line are well suited for SCR drives.




## PWM *Drives*

Pulse Width Modulated (PWM) drives perform well in similar applications as SCR drives with several more advantages. PWM drives add more flexibility to applications by being able to run on either AC or DC voltage. Their power devices switch at a rate over 120 times faster than SCR power devices thus producing "cleaner" DC voltages. A "clean" voltage means your motor will run cooler and quieter over a wider speed range (100:1 compared to 60:1 of SCR drives). A cooler brushed DC motor will require less maintenance to replace the brushes. The higher switching frequency is above the audible range, so there is no hum from the motor. The wider speed range allows you to run the motor slower while maintaining control. Applications requiring cool, quiet, lower maintenance operation are perfect for PWM drives.

For AC motor and control information, see page 49.
For Brushless control information, see page 67.

Speed range is usually defined as the ratio of maximum system speed to the minimum system speed. For example, if the maximum speed is 1,750 RPM, and the speed range is 100:1, the minimum speed will be 17.5 RPM. Using DC motors and drives as an example, let's analyze the three speed ranges listed below.

1) Motor speed range

2) Drive speed range

3) System speed range

## 1. Motor Speed Range

This is generally published as the fastest a motor can run trouble-free divided by the slowest it will run before it begins to "cog" (or "step"). Cogging occurs due to static friction in the motor, inefficiencies in a pre-mounted gearbox and/or spacing between the commutator slots of a DC brush motor. The fewer the number of slots, the sooner (or higher speed) the motor will "step".

Fan-cooled motors rely on the fan to stay below the maximum temperature of the motors. Often, a minimum fan speed is necessary, thus narrowing the motor speed range. Many motors can run at 1 1/2 to 2 times their rated speed. Their potential speed range may be artificially high.

## 2. Drive Speed Range

This is generally published as the maximum output voltage of the drive divided by the minimum output voltage of the drive. However, it should be published as the maximum output from the drive (where it can properly regulate motor speed), divided by the minimum output (when it can properly regulate motor speed).

The drive regulates motor speed by changing its output voltage in response to the motor load. More voltage will be applied when a motor begins to slow due to increased loading. Once the drive exceeds the maximum output voltage limit, it cannot output any additional voltage. At this point, the drive surpasses the speed range and fails to regulate properly.

The same concept holds true at minimum speed. The drive may be capable of running a motor, with "cogging," at 1 RPM. However, if the motor stalls when loaded, the drive speed range cannot be used at the lower end since the drive allowed the motor to stall.

## 3. System Speed Range

Those who specify a system, or end-users, are usually only concerned with the most important specification, the system speed range. However, the system speed range is a difficult specification to obtain from a catalog. Normal listings show motor speed range and drive speed range only; rarely will you find system speed range listed. We determine the system speed range by dividing the motor's speed at the maximum drive output voltage (with proper regulations) by the motor's minimum speed (before "cogging"). We combine only the motor and drive parameters that limit the system speed range. The maximum drive output is used because it is well below the maximum speed of the motor. The minimum speed of the motor is used because it is well above the minimum output of the drive (usually 2 to 3 volts are required to overcome the "dead zone" point of a motor).

Many things may affect the actual system speed range. Difficulties can arise when defining the minimum and maximum system speeds. For example, perhaps the bench tests and burn in were unidirectional. The way the brushes seat on the commutator could affect speed range in one direction. Ambient moisture might affect air gap fluxes of the commutator. Temperature changes in ambient air and/or the motor will affect magnetic field strength, thus affecting system speed range as well.

The most often overlooked culprit in narrowing the system speed range is the form factor of the drive output. The form factor from a drive worsens as motor speed reduces (lower output voltage) unless Minarik PWM drives are used. This is a major concern when specifying motors, and deserves its own explanation (see form factor discussion on pg. 107)

Consult Minarik's factory engineers for assistance in selecting a motor and drive that will meet your system's speed range requirements. Typically, Minarik specifies SCR drives for a 60 to 1 speed range. DC brush PWM drives are 80 to 100 to 1 speed range, and brushless DC drives for 80 to 1 speed range. Speed ranges beyond those listed involve Servo applications. If you have questions, contact the Minarik factory or sales engineers as they are all factory trained on Servo systems.

## REGULATION

We define the regulation speed of a DC brush-type motor as the drive's ability to hold a desired set speed as the load seen by the motor changes. We illustrate this below using the speed/torque curve of a DC motor controlled by DC drives. The horizontal line represents "perfect speed regulation" for a given motor. The motor speed does not change, not even 1 RPM, even though the motor experiences an increasingly heavier load.

Once the motor sees a load in excess of its rating, the drive may go into "current limit" to protect the motor. Until then, we want the drive to regulate speed. The amount of regulation required depends on the application; users set its value by calibrating the IR COMP trimpot on the drive. Drives can regulate motor speed even more accurately when they employ external feedback devices to monitor motor speed.

Applications requiring tight regulation might be:

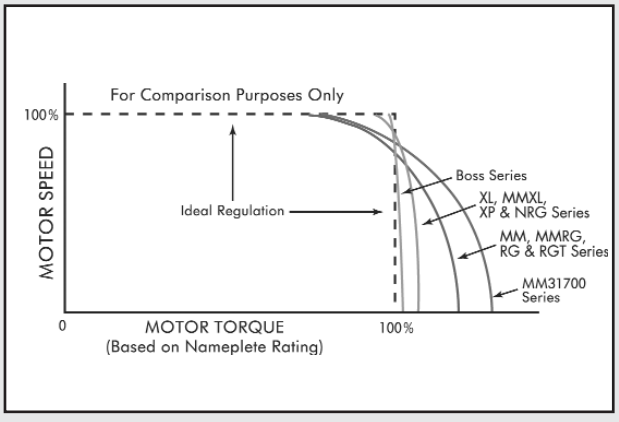
a) Cut-to-length
b) Leader-follower (involving multiple axes)
c) Winding applications
d) Printing, marking, labeling, and gluing (requires a high level of accuracy)

Applications where precise speed regulation may not be as critical:

a) High-speed braking and reversing applications (like index tables, palletizers, strapping, cranes, hoists, lifts)

b) Applications where simply moving from point A to point B is sufficient

c) Applications where an operator uses visual feedback (eyeballs) to make speed adjustments




## CURRENT LIMIT

Motors can handle currents in excess of their rated values for short periods of time. However, if operation outside of rated values occurs for an excessive duration of time, armature and brush life reduce, and eventually permanent motor damage will occur. Minarik drives generally possess a current limit (or torque limit) trimpot adjustment that allows users to limit the amount of current drawn by a motor. Consequently, users can limit the torque delivered to the load from a motor.

NOTE: THIS ADJUSTMENT IS DESIGNED TO LIMIT STEADY STATE OVERLOADS AND MAY NOT LIMIT VERY FAST CHANGING (IMPULSE) TYPE LOADS.

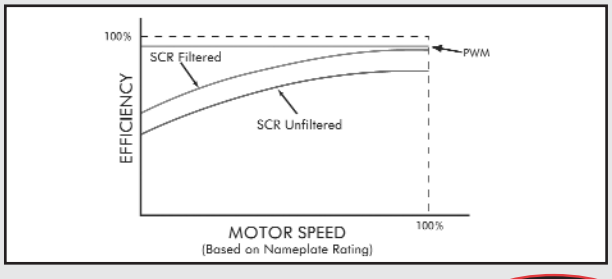


## EFFICIENCY

Efficiency is usually described as **h**= (power output ÷ power input) x 100% .

System efficiency corresponds inversely with power consumption from the power company. Higher system efficiencies consume less electricity than lower system efficiencies. They also correspond, though not linearly, with system life. Primarily, we are concerned with the efficiencies of the motor, drive and system.

When a device cannot convert all of the input power into work, the excess energy is wasted as heat and sometimes, noise. Usually, one must know the efficiency of the motor and drive only for a calculation of heat dissipation; for example, when sizing an enclosure for a drive. Another example might be the sizing of a cooling fan for a non-ventilated motor. The greatest contributing factor to motor and system efficiency is form factor. The graph below describes typical system efficiencies using Minarik drives.



## DEADBAND

Some Minarik regenerative drives contain the deadband feature for applications requiring the ability to adjust the time that elapses between current reversals. Adjustments to the deadband trimpot will alter the degree to which a motor resists changes in shaft position at zero speed. It performs this function by applying a small AC voltage to the motor armature.

## MINIMUM (MIN) & MAXIMUM (MAX) SPEED

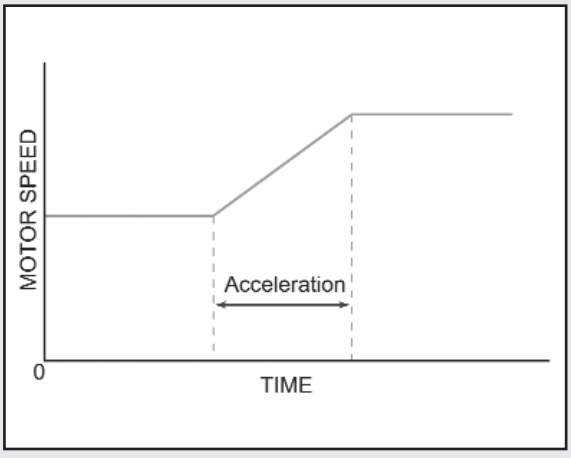
These application specific settings are present on most drives as a convenience to users. The minimum speed trimpot (MIN Speed) allows one to adjust output voltage to the motor when the reference to the drive is at a minimum. The reference may be 0 volts input with a 0-10 VDC signal, or with the main speed potentiometer turned fully counter clockwise. To adjust minimum speed to zero, turn the trimpot clockwise until the motor begins to rotate. Turn it slightly counterclockwise until the motor stops. Once completed, the drive will be unaffected by the voltage necessary to overcome static friction, the "dead zone" of the motor. As soon as the reference voltage input rises above zero, the motor will turn. If the application requires the motor to continue rotating, even with a zero reference input, rotate the MIN speed trimpot clockwise to the desired minimum speed. The minimum speed is important in applications such as conveyor ovens, where stopping the motor could damage the product in the machine.

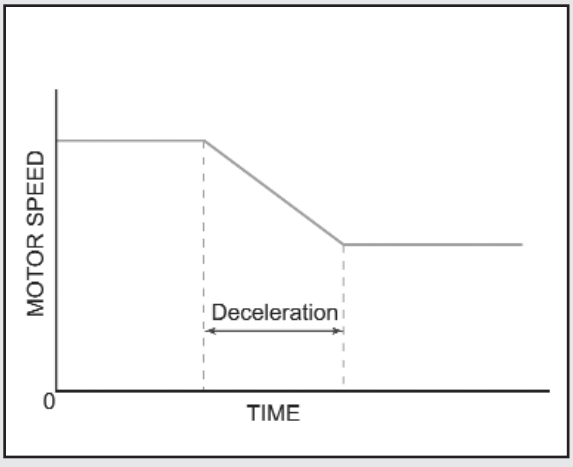
The maximum speed setting (MAX Speed) determines the fastest motor speed allowable when the main speed pot (or reference voltage) is at 100%. With this adjustment, we can overspeed the motor slightly, or we can limit the speed below the motor maximum speed rating. The MAX speed trimpot is especially useful when we cannot attain the exact motor for our desired speed. Simply use one that can go faster, and reduce the maximum speed setting during calibration.

## ADJUSTABLE ACCELERATION & DECELERATION

These settings are often referred to as soft start and soft stop. They are useful in applications that require the motor to ramp up to set speed, and ramp down to a slower speed; a filling machine conveyor is a good example. Here we don't want liquid in the containers to spill because of abrupt changes in speed. These trimpots are also useful in applications using an undersized motor due to space constraints (centrifuges for example). A very slow acceleration helps to avoid going into current limit as the motor accelerates to set speed.

Turning the acceleration or deceleration trimpot clockwise will lengthen the time it takes for the speed change to occur.

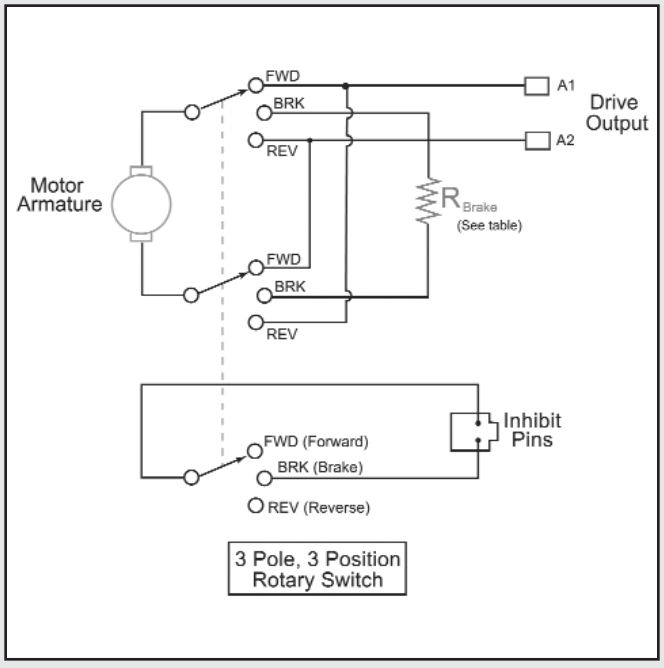


## DYNAMIC BRAKING

Minarik always recommends regenerative drives when applications require fast, contactorless braking and reversing. Even when reversing is not fast or frequent, regenerative drives may still be the most long term economical solution. However, certain situations may call for another method known as dynamic braking and reversing. This method uses a relay or switch rated for motor current, and a properly sized resistor. The brake resistor converts the energy of the load into thermal energy in the brake resistor. It is always recommended that the armature be disconnected only when the armature voltage is zero.

| Motor Amps | Recommended Brake Resistor $R_{Brake}$ | Watts |
|---|---|---|
| Less then 2 | 1Ω | 1W |
| 2A-3A | 5Ω | 5W |
| 3A-5A | 10Ω | 10W |
| 5A-10A | 20Ω | 20W |
| 10A-17A | 40Ω | 50W |

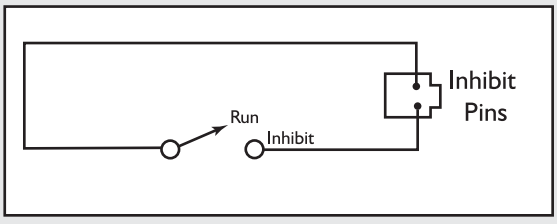



## INHIBIT

Depending on the application, users may want to ramp their motor down slowly (decelerate), while others may need to stop more quickly. For rapid or frequent motor stopping capability, most applications require regenerative drives. However, typical Minarik drives contain inhibit circuitry. Inhibiting a drive causes the output voltage to fall to zero or to a level determined by the minimum speed trimpot.

Inhibiting occurs by closing a switch on most drives, and opening a switch on others. Inhibiting single-quadrant drives simply reduces the drive output to zero (or a calibrated minimum voltage) which allows the motor and its load to coast. The drive applies no braking torque, rather the system friction provides the retarding forces. Inhibit bypasses the decel setting for "coast-to-stop". Opening the inhibit switch allows the motor to accelerate smoothly to its set speed.

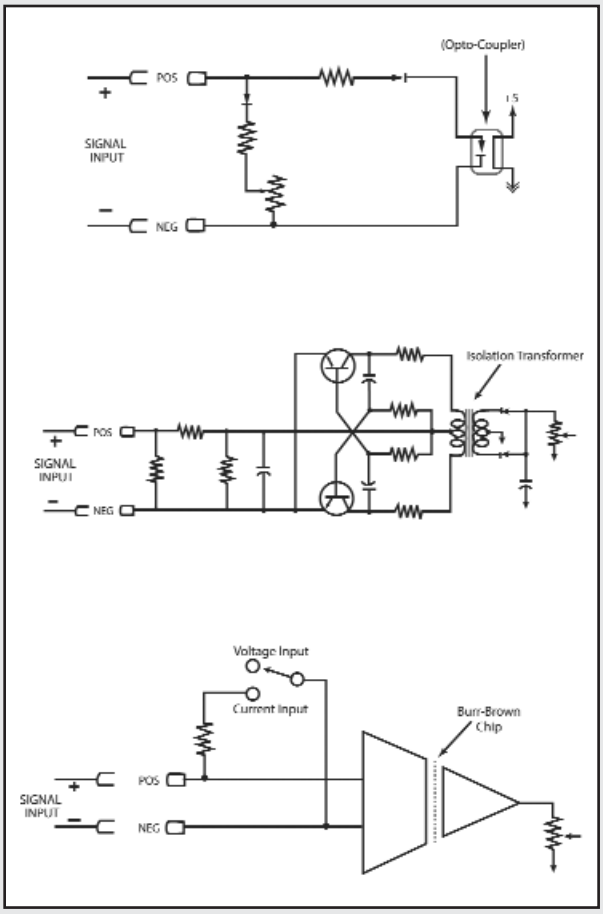
In four-quadrant (regenerative) drives, shorting the inhibit terminals will regeneratively brake the motor. It bypasses both the minimum speed and the deceleration settings for rapid braking determined by the torque trimpot setting. Depending on the drive wiring scheme, users can regeneratively brake a motor (following the deceleration setting) to a stop, decelerate the motor to minimum speed, or coast the motor to a stop (without removing power) by shorting the INHIBIT-RUN terminals.



Motor windings are simply coils of wire separated by insulating material. Only the base and outside of the motor is touching "earth ground." The drives use one of the wires coming from these motor coils as "common". Common is the point in the control circuit from which all other internal voltages are referenced. This part of the motor coil is the drive's zero reference.

Common and earth ground are at a high voltage potential from each other, typically equal to the line voltage. If we plugged a drive into a 115 VAC line socket, and measured the voltage from the drive's common to earth ground, we would see about 115 VAC. We say the drive floats above ground since these two points have a very large potential difference.

Often control signals from an external source (such as a PLC or transducer) are referenced to earth ground. If we set a grounded 0-10V analog signal to 0V, and measure from that point to earth ground, we would see "0V". An attempt to connect this source directly into the drive would result in catastrophic failure of the signal source and/or the drive. Therefore, we must use a device that provides good electrical isolation between these two points. An isolation device takes the incoming voltage from the signal source, and makes an "image" of this voltage, but isolated, for the drive to use as the reference. The output voltage is isolated from the ground and safe to wire to the drive.




There are three basic methods of isolation used by Minarik:

## 1. Opto-Coupled Isolation

This is the simplest and least linear method of isolation because an opto-coupler is designed to be an on-off device, not a variable voltage device. As a result, we occasionally receive voltage drops across certain junctions, and non-linearity due to temperature and age. However, this method is still acceptable for some applications. We use opto-coupled isolation in some older Minarik products like the PCM3 and the CF20000 drives.

## 2. Isolation Transformers

Minarik uses a simple push-pull transistor pair to transform an external DC signal into square-wave AC. SInce transformers can only transmit AC, the DC signal from the remote source must be "sampled" into AC. Then, the signal goes through a 1:1 isolation transformer; subsequently, a bridge rectifier converts it back into DC. This method is 2 to 3 times more linear than an opto-coupled device, but voltage drops still exist across the transistors and diode bridge. Our PCM20000, MM-PCM and PCMXP drives use this method.

## 3. Burr-Brown's® ISO Chip

This is Minarik's most reliable method of isolation. The Integrated Circuit (IC) uses a uniquely isolated op- amp, with feedback for excellent linearity. It is 300 times more linear than the opto-coupler and has better isolation than the other devices. More complex, the Burr-Brown IC requires support circuitry to run. Minarik provides separate isolation modules to use with any motor drive, or with isolation directly integrated into a drive. Minarik's PCM4 isolation module, PCM adder card, RG5500U, MM300, MM-PCM and MM500 series of drives use this method.

Form factor is a figure that indicates how much the current departs from pure DC. Mathematically, form factor is the quotient of RMS current and average (AVG) current.:

$$\frac{\text{RMS Current (AC)}}{\text{AVG Current (DC)}}$$

Unity form factor represents pure DC. Values greater than one indicate increasing departure from pure DC. The practical effects of larger form factor input into a motor include increased heating, decreased brush life, and diminished motor and system efficiency. The form factor rating of a motor defines the maximum form factor for which the stated motor ratings apply. The output form factor of the drive should never exceed the form factor rating of the motor.

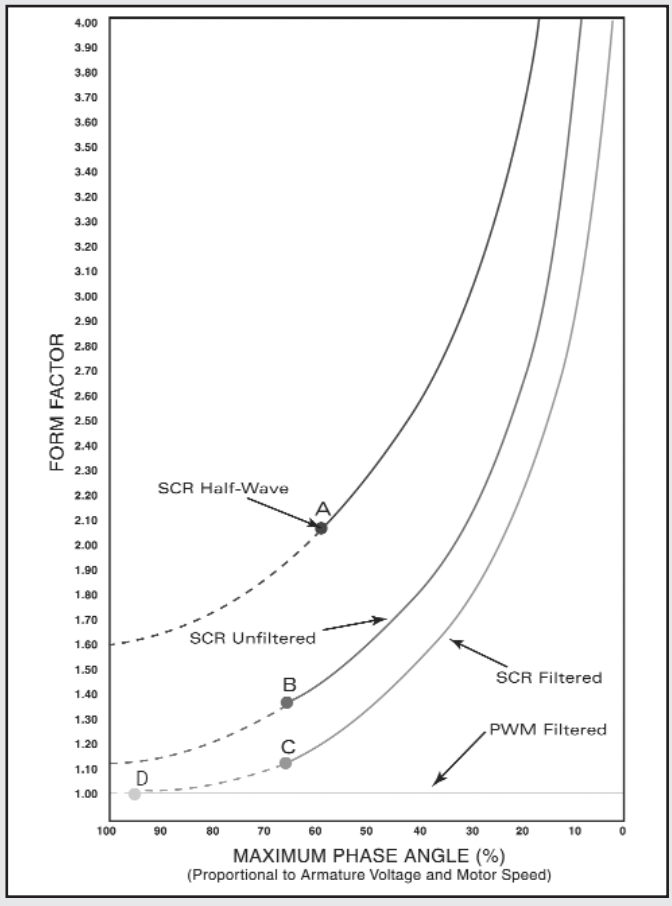
An unfiltered SCR drive output is not a fully rectified sine wave at maximum speed. Form factors of approximately 1.37 are typical for an unfiltered SCR drive operating at full speed. At lower speeds, the form factor of the armature output increases. The published form factor rating of an SCR drive indicates only its best (lowest) form factor value.

The form factor of filtered SCR drives at full speed can be as low as 1.05, but the typical value is closer to 1.10. Filtering raises both the RMS and the average current values and it reduces their difference. Filtered SCR drives exhibit less deterioration in form factor at lower voltage outputs than unfiltered SCR drives, but the form factor does rise with reduced speed, further reducing motor efficiency.

The form factor of filtered PWM drives does not exceed 1.05, nor does it deteriorated as speed reduces. The form factor rating of PWM drives is valid over the entire speed range, which accounts for the larger speed range of filtered PWM drives. The low form factor can be a substantial system advantage over SCR drives in terms of efficiency of operation and lower maintenance costs.

| Maximum Output Voltage (115 VAC Input) | |
|---|---|
| A | 75 VDC |
| B | 90 VDC |
| C | 115 VDC |
| D | 130 VDC |






NOTE: THE DASHED LINES (---) ON THE CURVES ON THE GRAPH, RIGHT, INDICATE WHEN THE DRIVES ARE OUT OF THEIR OPERATING RANGE.

When sizing a motor, torque is the most critical element to know. Once you know the motor requirement, sizing the drive is easy. The torque required from the motor is linearly proportional to the torque required to move the load.

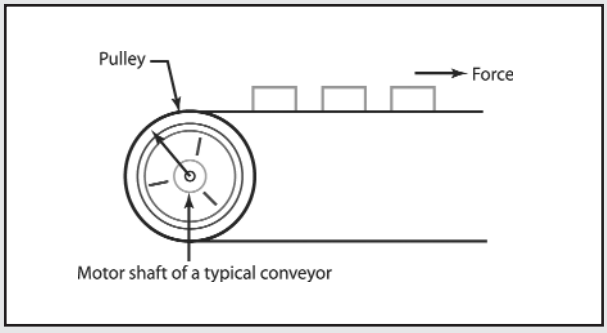
There are two simple methods for calculating torque:

## 1. Running Torque

Specify the running torque for applications where the motor operates continuously in one direction, or for infrequent reversals, where reverse time is not critical. This includes conveyors and similar loads. Use the calculation below for single-quadrant drives such as XL and MM Series.

$$\text{Torque (T)} = F \times r$$

F= Force necessary to move load at desired speed
r= radius or distance of load from center of motor shaft




NOTE: WHENEVER "FAST" ACCELERATION TIMES ARE REQUIRED, USE RG DRIVES AND NOTE ACCEL/DECEL TORQUE CALCULATIONS (SEE RIGHT).

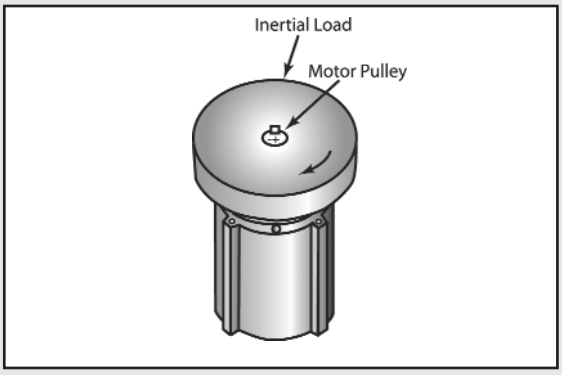
## 2. Acceleration/Deceleration Torque

Specify the Accel/Decel torque in any application where the time to accelerate and/or brake the load is critical. This includes indexing tables, winders, wrappers, strappers, as well as heavy inertial loads such as centrifuges and presses using flywheels. Use the calculation below for second and four-quadrant drives like the RG, NRG and BOSS.

$$\text{Torque (T)} = J \times a = J \times \frac{\Delta V}{\Delta t} \times \frac{1}{60}$$

J = Inertia of load (in-lb-sec$^2$)
a = Acceleration rate (rad/sec$^2$)
$\Delta v$ = The change of velocity (Rpm)
$\Delta t$ = The required time limit for the velocity change (Seconds)

If the torque required by the load exceeds the rating of the motor and drive, then they could run very hot. RG drives are the most susceptible since peak currents may exceed 6 times the current limit setting to assist in ultra-fast accelerations and braking. Continuously operating at these peak currents (instead of using a larger horsepower motor and drive) will result in blown fuses or circuit breakers as well as thermal degradation of the motor and drive. For maximum performance, size a DC motor and RG drive as if sizing a servo system.

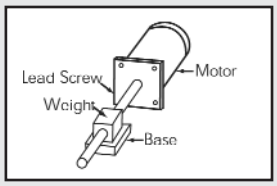


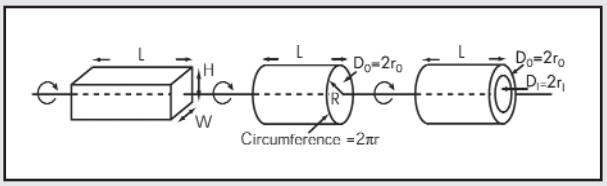

DC drives and motors are specified by horsepower. Thus, once torque is known, calculate the horsepower required for the application using the equation below:

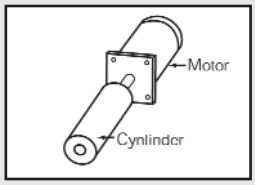
$$\text{Horsepower (Hp)} = T \times N/63025$$

T=Torque (in-lb)
N=Speed (rpm)

# Inertia Worksheet for Braking & Reversing Applications




## 1. LEADSCREW MECHANICAL SYSTEM

**A. Leadscrew Shaft Inertia**

1. Shaft Diameter (D) = _____Inches
2. Shaft Weight (W Shaft) = _____Pounds
   or Shaft Length (L) = _____Inches
   Shaft Density (d) = _____$lb/in^3$
3. Shaft Inertia (J Shaft) Calculation
   $= (W\ Shaft \times (D \div 2)^2) \div 2g$ or
   $= PI/32g \times d^4 \times L \times d$ = _____$lb\text{-}in^2$

**B. Reflected Load Inertia**

1. Load Weight (W Load) = _____Pounds
2. Leadscrew Pitch (P) = _____Rev/in
3. Efficiency (E) = _____%
4. Load Inertia (J Load) Calculation
   $= (W\ Load \div (E \times P^2) \times (1 \div (2 \times PI))^2$ = _____$lb\text{-}in^2$

**C. Total Inertia**

1. Add leadscrew shaft Inertia and load inertia
   J System = J Shaft + J Load = _____$lb\text{-}in^2$

**D. Friction**

1. Friction Force = _____lb
   F force = $\mu$ x W load
   $\mu$ = Coefficient of Friction
2. Total Friction Torque = _____lb-in
   F total = (F force) ÷ (P x E x 2 x PI)

| Friction Coefficients (Sliding) | $\mu$ |
|---|---|
| Steel on steel | .58 |
| Steel on steel (greased) | .15 |
| Aluminum on steel | .45 |
| Copper on steel | .36 |
| Brass on steel | .44 |
| Plastic on steel | .2 |
| Linear bearings | .001 |

| Mechanism Efficiencies | % |
|---|---|
| Acme screw (brass nuts) | .35–.65 |
| Acme screw (plastic nuts) | .5–.85 |
| Ball-Screw | .85–.95 |
| Preloaded ball-screw | .75–.85 |
| Spur or bevel gears | .9 |
| Timing Belt | .96–.98 |
| Chain and sprocket | .95–.98 |
| Worm gears | .45–.85 |

| Material Densities | oz $in^3$ | lb $in^3$ | gm $cm^3$ |
|---|---|---|---|
| Aluminum | 1.57 | .098 | 2.72 |
| Brass | 4.96 | .31 | 8.6 |
| Bronze | 4.72 | .295 | 8.17 |
| Copper | 5.15 | .322 | 8.91 |
| Plastic | .64 | .04 | 1.11 |
| Steel | 4.48 | .28 | 7.75 |
| Hard wood | .46 | .029 | .8 |
| Soft wood | .28 | .018 | .48 |

$A_{side} = L \times h$

$V = L \times h \times w$

$J = \frac{W}{12g} \times (h^2 + W^2)$

$A_{end} = \pi^2$

$V = A_{end} \times L$

$J = \frac{m\ D^2}{8} = \frac{W\ r^2}{2g}$

$J = \frac{\pi\ Ldr^4}{2g}$

$A_{end} = \frac{\pi}{4} \times (D_o^2 - D_i^2)$

$J = \frac{\pi\ Ld}{2g} \times (r_o^4 - r_i^4)$

$J = \frac{m}{8} \times (D_o^2 - D_i^2) = \frac{W}{2g} \times (r_o^2 - r_i^2)$

V = volume
L = length
h = height
w = width
J = inertia
m = mass
W = weight
D = diameter
r = radius
g = gravity = 386 $in/s^2$
d = density
A = area
$\pi$ = 3.14

## 2. CYLINDRICAL MECHANICAL SYSTEM

**A. Cylindrical Inertia**

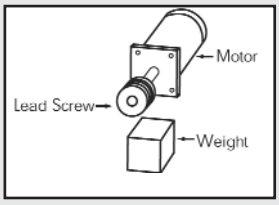
1. Outer Diameter (OD) = _____Inches
2. Inner Diameter (ID) [= 0 if Solid]
3. Weight (W) = _____Pounds
   or Length (L) = _____Inches
   Density (d) = _____$lb/in^3$
   $W = PI \times ((OD \div 2)^2) - ((ID \div 2)^2) \times L \times d$ = _____Pounds
4. Total Inertia (J System)
   $= .5 \times W\ ((OD \div 2)^2) + ((ID \div 2)^2)$ = _____$lb\text{-}in^2$
5. Total Friction Torque (F total) = _____oz-in

REFERENCE

K

# Reference

## 3. PULLEY MECHANICAL SYSTEM




**A. Motor Pulley Inertia**

1. Diameter (D Pulley) = _____Inches
2. Weight (W) if known = _____Pounds
   or calculate weight:
   Length (L) = _____Inches
   Density (d) = _____$lb/in^3$
   $W = PI \times (D\ Pulley \div 2)^2 \div 2 \times L \times d$ = _____Pounds
3. Pulley Inertia (J m System) Calculation
   $= W \times (D\ Pulley \div 2)^2 \div 2$ = _____$lb\text{-}in^2$

**B. Load Pulley Inertia**

1. Diameter (D Load) = _____Inches
2. Weight (W) if known or calculate weight:
   Length (L) = _____Inches
   Density (d) = _____$lb/in^3$
   $W = PI \times (D\ Pulley \div 2)^2 \div 2 \times L \times D$ = _____Pounds
3. Pulley Inertia (J 1 Pulley) Calculation
   $= W \times (D\ Pulley \div 2)^2$ = _____$lb\text{-}in^2$

**C. External Load Driven by Load Pulley**

1. Load Weight (W) = _____lbs
2. Load Inertia = _____$lb\text{-}in^2$
   $J\ load = W \times (D\ Load \div 2)^2$

**D. Gear Ratio**

$G = (D\ Load)/(D\ Pulley)$ = _____

**E. Total Inertia**

$J\ system = J\ m\ Pulley + (J\ 1\ Pulley) \div G^2 + (J\ Load) \div G^2$ = _____lb-in

**F. Total Friction Torque** (F Total) = _____oz-in

## UNITS for ELECTRICAL SPECIFICATIONS

| Unit | Symbol | Physical Quantity |
|---|---|---|
| ampere | A | electrical current |
| farad | F | electrical capacitance |
| henry | H | inductance |
| meter | m | length |
| ohm | Ω | electrical resistance |
| second | s | time |
| volt | V | electrical potential difference |
| watt | W | power |
| form factor | ff | rms current ÷ avg current |

## SIZING an ENCLOSURE

There are numerous issues to consider when sizing an enclosure for a drive: motor nameplate rating, type of material, style and appearance, environment, and internal volume of the drive. Two things affect the internal volume; first, the amount of depth for safe clearance of components mounted inside of the enclosure; second, the amount of volume necessary to dissipate the heat generated by the drive. We either dissipate heat through a heatsinking device (similar to an aluminum back plane), or by letting it flow out to the "ambient" air. If there is sufficient aluminum in the enclosure's back plane, then the internal volume may be smaller.

However, if using a plastic or steel enclosure, where little or no backplane exists to dissipate heat from the drive, then you will need to use forced air ventilation, or a larger volume inside the enclosure to dissipate the heat into the "ambient" air.

Most enclosure manufacturers use computers to quickly answer your questions and recommend the correct size enclosure for your drive.

### Depth

All Minarik's SCR drives require at least 1" of clearance at the top point of the drive. Filtered PWM drives (due to bus capacitors) require at least 2" clearance from the top. When mounting anything into the lid, remember to make accommodations in the depth behind the lid for components like switches and potentiometers.

### Heat Dissipation

Unfiltered SCR drives are typically 96% efficient, while filtered PWM drives are typically 94% efficient. We calculate the heat dissipation by multiplying the power output to the motor measured in watts (1 Hp motor at full load = 746 watts) by the inefficiency of the drive (1-**h**) = .04 for SCR drive, (1-**h**) = .06 for PWM drives).

## ENCLOSURE STANDARDS for Nonhazardous Locations

| Standard NEMA (IEC)* | Intended Use: Indoors | Intended Use: Outdoors | Provides protection against: Accidental bodily contact | Falling dirt | Dust, lint, fibers (non-volatile) | Windblown dust | Falling liquid, light splash | Indirect hosedown & heavy splash | Rain, snow & sleet | Oil or coolant seepage | Oil or coolant spray & splash | Corrosive agents |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEMA 1 (IP10) | ✘ | | ✔ | ✔ | | | | | | | | |
| NEMA 3 (IP54) | ✘ | ✘ | ✔ | ✔ | ✔ | | ✔ | | | ✔ | ✔ | |
| NEMA 4 (IP56) | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | |
| NEMA 4X (IP56) | ✘ | ✘ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ |
| NEMA 12 (IP52) | ✘ | | ✔ | ✔ | ✔ | | ✔ | | | ✔ | | |
| NEMA 13 (IP54) | ✘ | | ✔ | ✔ | ✔ | | ✔ | | | ✔ | ✔ | |

*The IEC equivalents listed in this column are approximate: NEMA types meet or exceed the test requirements for the associated IEC classifications.

## INGRESS PROTECTION (IP) CODES

| 1st Digit | Protection against foreign objects | 2nd Digit | Protection against moisture |
|---|---|---|---|
| 0 | Not protected | 0 | Not protected |
| 1 | Protected against objects >50mm | 1 | Protected against dripping water |
| 2 | Protected against objects > 12mm | 2 | Protected against dripping water when tilted up to 15N |
| 3 | Protected against objects > 2.5mm | 3 | Protected against spraying water |
| 4 | Protected against objects > 1.0mm | 4 | Protected against splashing water |
| 5 | Dust protected | 5 | Protected against water jets |
| 6 | Dust tight | 6 | Protected against heavy seas |
| | ---------- | 7 | Protection against the effects of immersion |
| | ---------- | 8 | Protection against submersion |

EXAMPLE MARKING: IP 68 would indicate a dusttight (1st digit 6) piece of equipment which is protected against submersion in water (2nd digit 8)

| Inertia Conversion Factors | | |
|---|---|---|
| lb-ft$^2$ x 144 | = | lb-in$^2$ |
| oz-in$^2$ x 0.0625 | = | lb-in$^2$ |
| lb-ft-sec$^2$ x 4600 | = | lb-in$^2$ |
| oz-in-sec$^2$ x 24 | = | lb-in$^2$ |
| gm=cm$^2$ x .000342 | = | lb-in$^2$ |
| kp-m-sec$^2$ x 33,500 | = | lb-in$^2$ |

| Metric-Decimal Equivalents | | |
|---|---|---|
| 1 inch | = | 2.54 cm |
| 1 cm | = | 0.3937 inch |
| 1 pond (gm) | = | 0.03527 oz |
| 1 oz | = | 28.35 pond(gm) |
| 1 kp (kg) | = | 2.205 pound |
| 1 gm-cm | = | 0.0139 oz.in |
| 1 kg-cm | = | 1 kp-cm=13.9 oz-in |
| 1 hp | = | 746 watts |
| °F | = | (°C x 9/5) + 32 |
| °C | = | (°F - 32) x 5/9 |

# Reference

## LENGTH*

| A \ B | mm | cm | m | in | ft |
|---|---|---|---|---|---|
| mm | - | 0.1 | 0.001 | 0.0393701 | 0.00328084 |
| cm | 10 | - | 0.01 | 0.393701 | 0.0328084 |
| m | 1000 | 100 | - | 39.3701 | 3.28084 |
| in | 25.4 | 2.54 | 0.0254 | - | 0.083333 |
| ft | 304.8 | 30.48 | 0.3048 | 12 | - |

## FORCE*

| A \ B | g | kg | oz | lbs | N |
|---|---|---|---|---|---|
| g | - | 0.001 | 0.035274 | 0.00220462 | 0.0098 |
| kg | 100 | - | 35.274 | 2.20462 | 9.807 |
| oz | 28.3495 | 0.0283495 | - | 0.0625 | 0.278 |
| lbs | 453.592 | 0.45392 | 16 | - | 4.448 |
| N | 101.97 | 0.102 | 3.597 | 0.2248 | - |

## VELOCITY*

| A \ B | ft/min | in/min | m/min | ft/sec | in/sec | m/sec |
|---|---|---|---|---|---|---|
| 1 ft/min | – | 12.0 | 0.3048 | $1.6667 \times 10^{-2}$ | 0.2000 | $5.08 \times 10^{-3}$ |
| 1 in/min | $8.333 \times 10^{-2}$ | – | $2.540 \times 10^{-2}$ | $1.3888 \times 10^{-3}$ | $1.6666 \times 10^{-2}$ | $4.23 \times 10^{-4}$ |
| 1 m/min | 3.281 | 39.372 | – | $5.468 \times 10^{-2}$ | 0.6562 | $1.667 \times 10^{-2}$ |
| 1 ft/sec | 60 | 720 | 18.29 | – | 12 | 0.3048 |
| 1 in/sec | 5 | 60 | 1.524 | $8.333 \times 10^{-2}$ | – | $2.540 \times 10^{-2}$ |
| 1 m/sec | 196.85 | 2362.2 | 60.0 | 3.281 | 39.372 | – |

## TORQUE*

| A \ B | Nm | Ncm | dyn cm | kgm† | kgcm† | gcm† | oz-in | lb-ft | lb-in |
|---|---|---|---|---|---|---|---|---|---|
| Nm | - | 100 | $10^7$ | 0.1019716 | 10.1972 | $1.019716 \times 10^4$ | 141.6121 | 0.7375633 | 8.850759 |
| Ncm | $10^{-2}$ | - | $10^5$ | $1.019717 \times 10^3$ | 0.1019716 | 101.9716 | 1.41612110 | $.7375633 \times 10^3$ | 0.08850759 |
| dyn cm | $10^{-7}$ | $10^{-5}$ | - | $1.019717 \times 10^{-6}$ | $1.019717 \times 10^6$ | $-1.019717 \times 10^{-3}$ | $1.416121 \times 10^{-5}$ | $7.375633 \times 10^{-8}$ | $8.850759 \times 10^{-7}$ |
| kgm† | 9.80665 | 980.665 | $9.80665 \times 10^7$ | - | 100 | $10^5$ | $1.3887407 \times 10^3$ | 7.233025 | 86.79630 |
| kgcm† | $9.80665 \times 10^{-2}$ | 9.80665 | $9.80665 \times 10^5$ | $10^{-2}$ | - | $10^3$ | 13.887407 | 0.07233025 | 0.8679630 |
| gcm | $9.80665 \times 10^{-5}$ | $9.80665 \times 10^{-3}$ | 980.665 | $10^5$ | $10^{-3}$ | - | 0.013887407 | $7.233025 \times 10^{-5}$ | $8.679630 \times 10^{-4}$ |
| oz-in | $7.061541 \times 10^{-3}$ | 0.7061541 | $7.061541 \times 10^4$ | $7.200768 \times 10^4$ | 0.07200768 | 72.00768 | - | $5.20833 \times 10^{-3}$ | 0.0625 |
| lb-ft | 1.355816 | 135.5816 | $1.355816 \times 10^7$ | 0.13825473 | 13.825473 | $1.382547 \times 10^4$ | 192 | - | 12 |
| lb-in | 0.1129846 | 11.29846 | $1.129846 \times 10^6$ | 0.011521228 | 1.1521228 | $1.151228 \times 10^3$ | 16 | 0.0833333 | - |

†Sometimes written as kpm, kpcm and pcm to denote the force equivalent of the kg and g mass.

## INERTIA*

| A \ B | $kgm^2$ | $kgcm^2$ | $gcm^2$ | $oz\text{-}in^2$ | $oz\text{-}in\text{-}sec^2$ | $lb\text{-}in^2$ | $lb\text{-}in\text{-}sec^2$ | $lb\text{-}ft^2$ | $lb\text{-}ft\text{-}sec^2$ (slug $ft^2$) |
|---|---|---|---|---|---|---|---|---|---|
| $kgcm^2$ | - | $10^4$ | $10^7$ | $5.457 \times 10^4$ | 141.612 | $3.41718 \times 10^3$ | 8.85076 | 23.7304 | 0.737563 |
| $kgcm^2$ | $10^{-4}$ | - | $10^3$ | 5.46745 | 0.0141612 | 0.341718 | $8.85076 \times 10^{-4}$ | $2.37304 \times 10^{-4}$ | 7.37563 $10^{-5}$ |
| $gcm^2$ | $10^{-7}$ | $10^{-3}$ | - | $5.467745 \times 10^{-3}$ | $1.41612 \times 10^{-5}$ | $3.41718 \times 10^{-4}$ | $8.85076 \times 10^{-7}$ | $2.37304 \times 10^{-6}$ | $7.37563 \times 10^{-6}$ |
| $oz\text{-}in^2$ | $1.82899 \times 10^{-5}$ | 0.182899 | 182.899 | - | $2.59009 \times 10^3$ | 0.0625 | $1.61880 \times 10^{-4}$ | $4.34028 \times 10^{-4}$ | $1.34900 \times 10^{-5}$ |
| $oz\text{-}in\text{-}sec^2$ | $7.06154 \times 10^{-3}$ | 70.6154 | $7.06154 \times 10^4$ | 386.088 | - | 24.1305 | 0.0625 | 0.1675 | $5.20833 \times 10^{-3}$ |
| $lb\text{-}in^2$ | 2.92630 | 2.92630 | $2.92630 \times 10^3$ | 16 | 0.0414414 | - | $2.59007 \times 10^{-3}$ | 6.9444 x 10 | 2.15840 x 10 |
| $lb\text{-}in\text{-}sec^2$ | 0.112985 | $1.12985 \times 10^3$ | $1.12985 \times 10^6$ | $6.17740 \times 10^3$ | 16 | 386.0892 | - | 2.63117 | 0.083333 |
| $lb\text{-}ft^2$ | 0.0421400 | 421.400 | $4.21400 \times 10^5$ | 2.304 x 10 | 5.96756 | 144 | 0.372972 | - | 0.0310809 |
| $lb\text{-}ft\text{-}sec^2$ (slug $ft^2$) | 1.35582 | $1.35582 \times 10^4$ | $1.35582 \times 10^7$ | $7.41289 \times 10^4$ | 192 | $4.63307 \times 10^3$ | 12 | 32.1740 | - |

*Multiply units of "A" by indicated factor to obtain units of "B".

# Agency Approvals

| PART NUMBER | PAGE # | UL | CUL | CSA | CE |
|---|---|---|---|---|---|
| MM23011C | 2 | Y | Y | Y | Y |
| MM23001C | 2 | Y | Y | Y | Y |
| MM23012D | 3 | Y | Y | Y | Y |
| MM23112D | 3 | Y | Y | Y | Y |
| MM23212D | 3 | Y | Y | Y | Y |
| MM23412D | 3 | Y | Y | Y | Y |
| MM23002D | 3 | Y | Y | Y | Y |
| MM23102D | 3 | Y | Y | Y | Y |
| MM23402D | 3 | Y | Y | Y | Y |
| MM23502D | 3 | Y | Y | Y | Y |
| M1 | 4 | Y | Y | N | N |
| M2 | 5 | N | P | N | N |
| PCM21000A | 6 | Y | N | Y | Y |
| PCM21010A | 6 | Y | N | Y | Y |
| PCM22000A | 6 | Y | N | Y | Y |
| PCM23001A | 6 | Y | N | Y | Y |
| MM311U | 7 | Y | Y | Y | Y |
| MM301U | 7 | Y | Y | Y | Y |
| MM501U | 7 | Y | Y | N | N |
| MM03-115AC-PCM | 8 | Y | Y | N | Y |
| MM10-115AC-PCM | 8 | Y | Y | N | Y |
| MM03-230AC-PCM | 8 | Y | Y | N | Y |
| MM10-230AC-PCM | 8 | Y | Y | N | Y |
| MM31701B | 9 | N | N | N | N |
| MM31751B | 9 | N | N | N | N |
| MM31700B | 9 | N | N | N | N |
| MM31750B | 9 | N | N | N | N |
| MM23201C | 10 | Y | Y | Y | Y |
| MM21151C | 10 | N | N | N | N |
| MM21251C | 10 | N | N | N | N |
| MM23101C | 10 | Y | Y | Y | Y |
| MC10 | 11 | Y | Y | N | N |
| MC10R | 11 | Y | Y | N | N |
| MC10-PCM | 11 | Y | Y | N | N |
| MM23411C | 12 | Y | Y | Y | Y |
| MM23401C | 12 | Y | Y | Y | Y |
| PCM23401A | 13 | Y | N | Y | Y |
| PCM23411A | 13 | N | N | N | Y |
| MMXL02-D240AC | 14 | Y | N | Y | Y |
| MMXL05-D240AC | 14 | Y | N | Y | Y |
| MMXL10-D240AC | 14 | Y | N | Y | Y |
| XL3025A | 15 | Y | N | Y | Y |
| XL3050A | 15 | N | N | N | Y |
| XL3200A | 15 | Y | N | Y | Y |
| XL3300A | 15 | N | N | N | Y |
| XP02-115AC | 16 | Y | N | Y | N |
| XP02-115AC-Q | 16 | N | N | Y | N |
| XP05-115AC | 16 | Y | N | Y | N |
| XP10-115AC | 16 | Y | N | Y | N |
| XP01-115AC-SL | 17 | Y | Y | N | N |
| XP03-115AC-SL | 17 | Y | Y | N | N |
| XP08-60DC | 20 | Y | Y | N | Y |
| DC16-12/24 | 19 | Y | Y | N | Y |
| DC60-12/24 | 19 | Y | Y | N | Y |
| DC60-36/48 | 19 | Y | Y | N | Y |
| DC5004Q-36/48 | 18 | N | N | N | Y |
| XP16-36/48DC | 20 | Y | Y | N | Y |
| XP32-12/24DC | 20 | Y | Y | N | Y |
| XP60-12/24DC | 20 | Y | Y | N | Y |
| LV01-24AC | 21 | Y | Y | N | Y |
| LV02-24AC/DC | 21 | Y | Y | N | Y |

Y = YES  N = NO  P = PENDING

| PART NUMBER | PAGE # | UL | CUL | CSA | CE |
|---|---|---|---|---|---|
| PCMXP02-115AC | 22 | Y | N | Y | N |
| PCMXP05-115AC | 22 | Y | N | Y | N |
| PCMXP10-115AC | 22 | Y | N | Y | N |
| C1XP01-115AC-A | 23 | Y | N | Y | Y |
| C1XP03-115AC-A | 23 | Y | N | Y | Y |
| C4XL3025A | 24 | N | N | N | Y |
| C4XL3200A | 24 | N | N | N | Y |
| RG510UA | 25 | Y | Y | Y | Y |
| RG500UA | 25 | Y | Y | Y | Y |
| RG5500U | 26 | Y | Y | N | N |
| RG60U | 27 | Y | Y | N | N |
| RG60U-T | 27 | Y | Y | Y | N |
| MMRG31U | 28 | Y | N | Y | Y |
| MMRG30U | 28 | Y | N | Y | Y |
| MMRG40U | 28 | Y | N | Y | Y |
| MMRGD03-D230AC | 29 | N | Y | N | Y |
| MMRGD10-D230AC | 29 | Y | Y | N | Y |
| RGT300U | 30 | Y | Y | Y | Y |
| RGT310U | 30 | Y | Y | Y | Y |
| RGT400U | 30 | Y | Y | Y | Y |
| RG25U | 31 | Y | N | Y | Y |
| RG51UA | 31 | Y | N | Y | Y |
| NRG02-D240AC-4Q | 32 | Y | N | N | Y |
| NRG05-D240AC-4Q | 32 | Y | N | N | Y |
| NRG10-115AC-4Q | 32 | Y | N | N | Y |
| NRG02-D240AC-2Q | 33 | Y | N | N | Y |
| NRG05-D240AC-2Q | 33 | Y | N | N | Y |
| NRG10-115AC-2Q | 33 | Y | N | N | Y |
| RG500A | 34 | Y | Y | Y | Y |
| RG510A | 34 | Y | Y | Y | Y |
| RG501A | 35 | Y | Y | N | N |
| RG511A | 35 | Y | Y | Y | Y |
| C1RGD03-D230AC | 36 | N | N | N | N |
| C1RGD10-D230AC | 36 | N | N | N | N |
| VFD Series | 53 | Y | Y | N | N |
| MAC Series | 54 | N | Y | N | Y |
| ACM100 Series | 55 | Y | Y | N | N |
| AC200 Series | 56 | Y | Y | N | N |
| AC300 Series | 59 | Y | Y | N | N |
| AC400 Series | 59 | Y | Y | N | N |
| LVBL02-24AC/DC | 68 | Y | Y | N | Y |
| LVBL06-24AC/DC | 68 | Y | Y | N | Y |
| BOSS04AC-1Q | 69 | P | N | N | P |
| BOSS08AC-1Q | 69 | P | N | N | P |
| BOSS15AC-1Q | 69 | P | N | N | P |
| BOSS04-D240AC-4Q | 70 | Y | N | Y | Y |
| BOSS08-D240AC-4Q | 70 | Y | N | Y | Y |
| BOSS15-115AC-4Q | 70 | Y | N | Y | Y |
| BOSS04-D240AC-CM | 71 | Y | N | Y | Y |
| BOSS08-D240AC-CM | 71 | Y | N | Y | Y |
| BOSS15-115AC-CM | 71 | Y | N | Y | Y |
| MMBOSS05-24DC-1Q | 72 | Y | N | N | N |
| DLC600 | 87 | Y | N | N | Y |
| VT8-D230AC | 88 | Y | N | N | N |
| PCM4 | 90 | Y | N | Y | Y |
| PCM Option | 90 | N | N | N | N |
| 200-0386A | 90 | N | N | N | N |
| VFD05-D230AC-PCM | 50 | Y | Y | N | N |
| VFDP4X04-D230AC-PCM | 52 | Y | Y | N | N |
| VFDA4X04-D230AC-PCM | 51 | N | N | N | N |
| VFDF4X04-D230AC-PCM | 51 | N | N | N | N |

Y = YES
N = NO
P = PENDING

**Acceleration/Deceleration** The time rate of change in velocity; acceleration refers to an increase in velocity, while deceleration refers to a decrease in velocity. Generally expressed as radians/sec/sec. Board-mounted trimmer potentiometers let users adjust the time it takes for the motor to reach set speed.

**Actuator** A device that converts various forms of energy, when given an input, to rotating or linear mechanical motion such as a motor.

**Air-Gap** The area between the rotating and stationary members of an electric motor.

**Alternating Current (AC)** Electrical current flow, usually generated by the utilities at 60 Hz, which continuously reverses direction in the middle of its cycle. Mathematically, it follows a sine wave; it travels from zero, then reaches a maximum in one direction, decreases to zero, then reverses to reach a maximum in the opposite direction.

**Ambient Temperature** The temperature of the medium, usually air, around a device such as a motor or drive.

**Ampere (AMP)** The standard unit of electrical current, or rate of electron flow. A closed-loop electrical circuit with one volt of potential difference across one Ohm of resistance causes one ampere of current to flow.

**Armature** The armature is the rotating member of an electric motor. In brush-type DC motors, it consists of the main current carrying windings (conductors) in the rotor. The commutator switches the power supply to the armature windings to generate a magnetic field.

**Back-Emf** Also known as counter emf (cemf), it is the voltage produced across motor windings, due to the winding turns being cut by a magnetic field, during rotation of the motor. The back-emf is directly proportional to rotor velocity and opposite in polarity to the applied voltage. This static voltage arises from the generator action in a motor, even if the motor windings are not energized.

**Backlash** In a mechanical system, backlash is the relative motion between two devices, connected by a coupler, gear, screw, etc.

**Bridge Rectifier** A section of the DC drive that converts the AC power supply into a DC source.

**Brushes** The current conducting material, usually carbon or graphite, which rests directly on the commutator of brush-type DC motor. They transmit current from the power supply to the armature.

**Capacitor** A device which holds electrical charge for a period of time, prevents the flow of direct current and allows the flow of alternating current. These components serve as filters in DC drives to provide a "cleaner" DC signal to the motor.

**Chassis** Open construction of a drive for mounting within a customer's existing enclosure or control console.

**Choke** A filter device consisting of an inductor and a resistor. Although more expensive than a typical RC filter, they exhibit better performance.

**Closed-loop** A system that uses feedback information to regulate the output response. The output feeds back to a controller for comparison to the input command; any difference results in a corresponding change in the input command. Thus, the accuracy increases.

**Cogging** Cogging refers to shaft rotation occurring in jerks or increments rather than smooth continuous motion. The non-uniform ("jerky") rotation results from the armature's propensity to certain discrete angular positions. The interaction of the armature coils entering and leaving magnetic fields, produced by the field coils or permanent magnets, causes speed changes. The armature tends to speed up and slow down as it cuts through the fields during rotation. Cogging is very apparent at low speeds, and determines a motor's speed range.

**Commutator** A device mounted on the armature shaft and consisting of a number of wedge shaped copper segments arranged around the shaft. These segments are insulated from the shaft and from each other. The motor brushes ride on the periphery of the commutator, and electrically connect and switch the armature coils to the power source.

**Conductor** Any material, such as copper or aluminum, which offers little resistance to the flow of electric current.

**Current Limit (Torque Limit)** This feature permits the operator to adjust the maximum current the motor can draw. This, in effect, limits the maximum torque the motor will produce.

**Dynamic Braking** A way of quickly stopping a motor by disconnecting the power source. The rotating motor then becomes a generator. When connected to a resistor, the energy of rotation is then dissipated as heat in the resistor.

**Duty Cycle** The ratio of operating time versus total cycle time of a motor. A motor has a continuous duty rating if it continues to operate for an indefinite amount of time and its normal operating temperature remains within the temperature limits of its insulation system. A motor has an intermittent duty rating if it never reaches a steady temperature, but is allowed to cool between operations.

**Enclosure** A description of the motor or drive housing. The selected enclosure depends on the application's environment and heat generated by the device.

**Encoder** A feedback device that translated mechanical motion into an electronic signal or combination of signals (pulses).

Field Motor field windings provide the magnetic field, located in the stator of DC shunt-wound motor, which interacts with the armature field to produce torque. PM motors use magnets, instead of windings, to produce the stator field.

**Filter** An electrical device used to suppress electrical noise, or to improve the DC output to a DC motor.

**Flyback Diode** This is a super fast recovery diode that snubs current and voltage spikes as a result of the fast transients that occur when IGBT, and MOSFETS are turned on and off quickly.

**Form Factor** Form factor indicates how much AC component resides in the DC output from DC drives. Represented mathematically as the ratio of a signal's root-mean square current value to its average current value. Any form factor value greater than one means that some of the current produces heat instead of torque.

**Four-quadrant** This term refers to a drive's ability to control the velocity and torque of a motor in either direction of rotation. The direction of torque can be in the opposite direction of the velocity for applications requiring braking or deceleration. Single-quadrant drives, on the other hand, only produce torque and velocity in the same direction of rotation.

**Frequency** Frequency refers to how often a complete cycle occurs in a unit of time. Frequency is usually measured in cycles per second, or Hertz, where 1 cycle/second equals 1 Hz. The standard AC power supply in the USA is 60 Hz, while 50 Hz remains common in many other countries of the world.

**Friction** The resistance to motion between surfaces

**Fuse** A device connected to an electrical circuit designed to melt and open the circuit in the event of excess current flow.

**Gearhead** A mechanical device that converts speed and torque to values required by the application. Output torque increases, and output speed decreases proportionally to the gear ratio.

**Generator** A machine that converts mechanical energy into electric energy.

**Hall Effect Sensor** These feedback devices, commonly used in brushless motors, provide information for the amplifier to electronically commutate the motor. The sensors generate commutation signals by sensing the position of a magnetized wheel on the rotor.

**Horsepower** The rate at which work is performed. It equals the speed multiplied by torque, and a constant, depending on the units selected.

**Inductance** A property of an electric circuit that represents its ability to resist changes in current flow.

**Inertia** A function of the mass and shape of an object. The inertia represents the property of an object that resists a change in motion. An object's inertia increases directly with an increase in the object's mass; also, increasing inertia loads require more force to accelerate and decelerate them.

**Inverter (Variable Frequency Drives)** AC drive that varies the frequency and voltage applied to an AC motor to vary motor speed.

**IR Compensation** It varies the mount of voltage to the armature in response to current (load) changes. It is adjustable via a

# Glossary

board mounted trimmer potentiometer.

**Isolated Gate Bipolar Transistor gate (IGBT)** A power transistor with a gate similar to the base of BJT. The difference is that the gate is electrically insulated from the collector-emitter circuit. This allows high voltages and currents to be conducted.

**Jogging** This feature provides a means of momentarily moving the motor at a different speed (normally slower) from the normal operating speed. Operators access this function using a separate control input.

**Load** A term used to describe work require form a motor to drive equipment attached at the shaft. Usually defined in units of horsepower, or torque at a certain speed.

**MOSFET** A Metal-Oxide-Semiconductor-Field-Effect-Transistor is similar to standard field-effect transistors. MOSFETs can be a N or P type. They will or will not conduct from source to drain unless a voltage is applied to the gate of the MOSFET. They have turn-on and turn-off capability, as well as fast reaction times.

**NEMA** The acronym stands for the National Electrical Manufacturers Association. The agency provides specification standards for motors and drives.

**Noise (EMI/RFI)** Electrical disturbances that interfere with proper transmission of electrical signals. Noise can have adverse effects on the system performance.

**Non-volatile Memory** A memory storage system that maintains information during the loss of power.

**Ohm** Unit of electrical resistance of a circuit in which a potential difference of one volt produces a current of one ampere.

**Open-Collector** An output signal, provided by a transistor, where the "open-collector output" acts like a switch closure to ground when activated.

**Open-Loop** A system that does not use feedback information to regulate performance.

**Phase Lock Loop (PLL)** Used for error correction, PLL refers to an external digital controller that monitors digital feedback proportional to velocity. It compares that to a known number of counts that should be seen within a specified time frame, and calculates error based on its feedback. Minarik uses Phase Lock Loop on digital front-ends such as the DLC Series.

**PLC** A programmable logic controller (PLC) uses programmed logic instructions to control banks of inputs and outputs which interface timed switch actuation to external electro-mechanical devices.

**Plugging** A method to provide quick stopping or reversing of a motor by applying partial or full reverse voltage on the motor terminals during operation. Not recommended for DC systems since the life of the motor and drive reduces, while permanent damage may result.

**Poles** The magnetic poles in an electric motor that result from connection and placement of the windings in the motor. Besides poles created by electricity, permanent magnets mounted in specific areas are poles with a constant orientation.

**Potentiometer (Pot)** A passive device (variable resistor) used to vary voltage between a minimum and maximum level. The standard speed pot is a 300° or single-turn. Operators control the speed of a motor from the potentiometer connected to a drive. Also, board-mounted trimmer pots allow users to make calibrations.

**Proportional-Integral-Derivative** The act of recognizing a velocity or position error in a system, and applying correction (or voltage change) to the system amplifier, thereby changing the motor's speed or altering position. PID refers to a group of gain parameters that tune or optimize the response of a closed-loop system.

1. Proportional: This feedback loop compares error and adds an equal amount of reference beyond the original. For example: with a 20% error, the loop applies 20% more than the original reference.

2. Integral: This loop examines the average error over a number of samples, and makes the correction associated with it. For example: with a 20% error reading in one window and 10% error in another, the integral loop may apply 15% error correction in the third window based on average of previous readings.

3. Derivatives: This loop reads instantaneous change in error, as opposed to the error itself. It analyzes how an error differs from a previous error and adjusts accordingly. PID combines all three loops resulting in an extremely accurate form of digital error correction. Each loop checks and balances the other to assure the right amount of error correction. Lead-Lag is similar to PI in correcting error through known error and average error. The difference is that this can over or under compensate, based on a trend or assumption of what is assumed will occur in the next error. The error correction can lead or lag the actual error.

**Rated Values** The rated value of a parameter (voltage, temp, etc.) is the maximum value that the parameter can reach in an electric device operating continuously without undue degradation, loss of its basic properties, or safety hazards.

**Regenerative** Regenerative drives, often used interchangeably with four quadrant drives, applies to the regeneration of energy from the motor and drive, back to the power source. A motor generates when the load forces the motor to go faster than the drive has set. Four quadrant drives can prevent motors from over speeding. A four quadrant drive is regenerative when it puts the generated energy back into the source, like a battery or the AC line. Also, the energy could be dumped across a dynamic brake resistor or a dump resistor, as is the case in a non-regenerative, four quadrant drive.

**Relay** These electronic components control other devices in a circuit. A set of contacts, the switching mechanism, open or close when the relay's magnetic coil becomes energized.

**Resistance** The opposition to current flow through a conductor in a closed circuit.

**Rotor** The rotating assembly of a motor. Usually includes a shaft, fan and rotor core.

**Silicon Controlled Rectifier (SCR)** Also known as a thyristor, a SCR is basically a diode with an extra junction tied to a third leg, known as the gate between the cathode and anode. SCRs prevent current flow in either direction until the gate receives a voltage signal. After receiving this trigger signal, the SCR then becomes a diode. It remains on, regardless of what happens at the gate, until the zero crossing, at which point current cease to flow.

**Servo** A system consisting of an amplifier, actuator, and feedback element. Servos tend to control one or combination of the following variables: position, velocity and torque.

**Speed Regulation** Defined as the deviation in motor speed from ***No Load to Full Load***; usually expressed as a percentage of base speed. Feedback devices, like a tachometer or digital closed loop control, provide increased regulation.

**Stator** The stationary part of a motor. A PM DC motor holds its magnets in the stator.

**Surge Suppressors** These devices, like a metal oxide varistor (MOV), suppress voltage transients that can occur on the AC line.

**Tachometer Feedback** A tachometer (tach) generates a voltage proportional to speed. Tachs provide a closed-loop system with excellent speed regulation.

**Torque** A rotational force equal to an equivalent linear force applied at a right angle to a radius of ***r***.

**Torque-to-Inertia Ratio** The rated motor torque divided by its rotor inertia. Helps determine a motor's ability to accelerate loads.

**Transformer** A passive device that raises or lowers AC voltage by induction.

**TTL (Transistor-Transistor Logic)** A popular family of integrated circuit devices that operate from logic level voltages, 5 to 12 VDC.

**Voltage** Voltage is electric pressure. A volt is a unit of electromotive force which causes 1 Amp of current to flow through a 1 Ohm resistor.

**Watts** The power required to maintain one ampere of current at a pressure of one volt when the two components are in phase with each other. A unit of horsepower is equal to 746 watts.

| OLD MODELS | NEW MODELS | FOOTNOTES | OLD MODELS | NEW MODELS | FOOTNOTES |
|---|---|---|---|---|---|
| AC75 | No longer available | #1 | MM201 | MM23401C | #5 |
| AC100 | No longer available | #1 | MM201U | MM301U | #3, #5 |
| AC200 | No longer available | #1 | MM2111A | MM23111C | #5 |
| BC90 | No longer available | #1 | MM21211A | MM23211C | #5 |
| BC90UD4 | MM23001C | | MM23001C-H | MM23001C-Q | #5 |
| BC290 | MM23101C | | MM23101A | MM23101C | #5 |
| BC290UD4 | MM23001C | | MM23201A | MM23201C | #5 |
| BC2110UD4 | MM501U | | MM23401A | MM23401C | #5 |
| BC2150UD4 | MM501U | | MM23411A | MM23411C | #5 |
| BCT198UD4 | No longer available | #1 | MM23021A | XL3300A or MM501U | #5 |
| BCT2150UD4 | No longer available | #1 | MM31002A | MM23001C | #5 |
| C80U | MM23001C | #1 | MM31700A | MM31700B | #5 |
| C85U | MM23001C | | MM31701A | MM31701B | #5 |
| C280U | MM23001C | | MM31750A | MM31750B | #5 |
| C285U | MM23001C | | MM31751A | MM31751B | #5 |
| DLC120 | DLC600 | #5 | MMR50 | MM21211A or RG510A | #2 |
| DLC240 | DLC600 | #5 | MMR51 | MM21211A or RG510A | #2 |
| DLC300 | DLC600 | #5 | MMR100 | RG500A | #5 |
| DLC300-SPEC.0404 | DLC600 | #5 | MMR101 | RG500A | #5 |
| DLC400 | DLC600 | #5 | MMR200 | RG500A | #5 |
| DLC400-SPEC.0404 | DLC600 | #5 | MMR201 | RG500A | #5 |
| DLC500 | DLC600 | #5 | MMR35 | MM23201C | |
| E10U | No longer available | #1 | MMR60 | MM23201C | |
| E15U | MM31610A | #5 | MMR90 | MM23201C | |
| E16U | MM31610A | #5 | MMR230 | MM23201C | |
| E50U | MM23001C | #5 | MMR250 | MM23201C | |
| E51U | MM23001C | #5 | MMR260 | MM23201C | |
| E250U | MM23001C | #5 | MMR290 | MM23201C | |
| E251U | MM23001C | #5 | MR6 | MM21251C | |
| FDC30 | No longer available | #1 | MR14 | MM21251C | |
| M3U | XP01-115AC-SL | | N80 | MM23401C | |
| M3UD2 | XP01-115AC-SL | | N280 | MM23401C | |
| M6 | MM21151C | | NR80 | RG500A | |
| M6UD1 | XL3025A | | NR280 | RG500A | |
| M6UD2 | XL3025A | | PCM1 | PCM4 | |
| M6UD3 | XL3025A | | PCM2 | PCM4 | |
| M6UD4 | XL3025A | | PCS1 | PCM4 | |
| M14 | MM21151C | | PCS2 | PCM4 | |
| M14UD1 | XL3025A | | PK3 | PK15 OR PK17 | |
| M14UD2 | XL3025A | | PK4 | PK16 | |
| M14UD3 | XL3025A | | RC115 | No longer available | #1 |
| M14UD4 | XL3025A | | RC230 | No longer available | #1 |
| M26UD1 | XL3025A | | RG50 | RG510A | #2 |
| M26UD2 | XL2035A | | RG50U | RG51UA or RG500UA | |
| M26UD3 | XL3025A | | RG51U | RG51UA or RG500UA | |
| M26UD4 | XL3025A | | RG101UC | RG101UD | #5 |
| M35 | MM23101C | | RG201UC | RG201UD | #5 |
| M60 | MM23101C | | RG100UA | RG100UC or RG500UA | |
| M90 | MM23101C | | RG100UB | RG100UC or RG500UA | |
| M230 | MM23101C | | RG101UA | RG101UD | #5 |
| M250 | MM23101C | | RG101UB | RG101UD | #5 |
| M260 | MM23101C | | RG102UA | No longer available | #1 |
| M290 | MM23101C | | RG200UA | RG200UC OR RG500UA | |
| MB653U | RD16U | | RG200UB | RG200UC OR RG500UA | |
| MM50 | MM23111C | #2 | RG201UA | RG201UD | #5 |
| MM50U | MM311U | #2 | RG201UB | RG210UD | #5 |
| MM51 | MM23111C | #2 | RG202UA | No longer available | #1 |
| MM51U | MM311U | #2 | RG300A | RG500A | #5 |
| MM100 | MM23401C | #5 | RG300UA-PCM | RG500UA-PCM | #5 |
| MM100U | MM301U | #3, #5 | RG310UA | RG510UA | #5 |
| MM101 | MM23401C | #5 | RG310UA-PCM | RG510UA-PCM | #5 |
| MM101U | MM301U | #3, #5 | RG400A | RG500A | #5 |
| MM200 | MM23401C | #5 | RG400UA | RG500UA | #5 |

| OLD MODELS | NEW MODELS | FOOTNOTES |
|---|---|---|
| RG400UA-PCM | RG500UA-PCM | #5 |
| RG300UA | RG500UA | |
| SH12 | SL15 | |
| SH12FB | SL15 | |
| SH14 | SL15 | |
| SH32 | MM21251C | |
| SH32FB | MM21251C | |
| SH33 | MM21251C | |
| SH52 | MM21251C | |
| SH52FB | MM21251C | |
| SH53 | MM21251C | |
| SH63 | MM21251C | |
| SH73 | No longer available | #1 |
| SH83 | No longer available | #1 |
| SH273 | No longer available | #1 |
| SH283 | No longer available | #1 |
| SH293 | No longer available | #1 |
| SL10U | XP01-115AC-SL | #5 |
| SL14 | SL15 | |
| SL14P | No longer available | #1 |
| SL15U | XP01-115AC-SL | #5 |
| SL31UD1 | XL3025A | |
| SL31UD2 | XL3025A | |
| SL31UD3 | XL3025A | |
| SL31UD4 | XL3025A | #5 |
| SL32 | MM21251C | #4, #5 |
| SL51UD1 | XL3025A | |
| SL51UD2 | XL3025A | |
| SL51UD3 | XL3025A | |
| SL51UD4 | XL3025A | #5 |
| SL52 | MM21251C | #4, #5 |
| SL58 | MM21251C | |
| SL58U | XL3025A | |
| SL61 | MM21151C | |
| SL61UD1 | XL3025A | |
| SL61UD2 | XL3025A | |
| SL61UD3 | XL3025A | |
| SL61UD4 | XL3025A | |
| SL63 | MM21251C | |
| SLF38 | MM21251C | |
| SLF38UD4 | XL3025A | |
| SLF58 | MM21251C | |
| SLF58UD4 | XL3025A | |
| SLF61 | MM21151C | |
| SLF63 | MM21251C | |
| SLF67 | MM21151C | |
| SLF68 | MM21251C | |
| SLF68UD4 | XL3025A | |
| SLF69 | MM21151C | |
| SLF70 | MM21251C | |
| SLF88 | No longer available | #1 |
| SLF88XF | No longer available | #1 |
| SLF298 | No longer available | #1 |
| SLT18UD4 | No longer available | #1 |
| SLT38UD4 | No longer available | #1 |
| SLT58UD4 | No longer available | #1 |
| SLT68UD4 | No longer available | #1 |
| SLT78UD4 | No longer available | #1 |
| SLT298UD4 | No longer available | #1 |
| SSR21010A | RG500UA | |
| SSR21000A | RG500UA | |
| SSR22000A | RG500UA | |
| TA100P | TA101P | #5 |
| TR9020U | No longer available | #1 |
| VT2-115 | VT7-115 | #5 |
| VT3-230 | VT7-230 | #5 |
| VT6-115 | VT7-115 | #5 |
| VT6-230 | VT7-230 | #5 |
| W12 | No longer available | #1 |
| W14 | No longer available | #1 |
| W32 | MM21251C | |
| W33 | No longer available | #1 |
| W52 | MM21251C | |
| W53 | No longer available | #1 |
| W63 | No longer available | #1 |
| W63RM | No longer available | #1 |
| W73 | No longer available | #1 |
| W83 | No longer available | #1 |
| W203 | No longer available | #1 |
| W273 | No longer available | #1 |
| W283 | No longer available | #1 |
| W293 | No longer available | #1 |
| WP10 | No longer available | #1 |
| WP11 | No longer available | #1 |
| WP12 | No longer available | #1 |
| WP15 | No longer available | #1 |
| WP20 | No longer available | #1 |
| WP21 | No longer available | #1 |
| WP24 | No longer available | #1 |
| WP25 | No longer available | #1 |
| WP32 | No longer available | #1 |
| WP50 | No longer available | #1 |
| WP51 | No longer available | #1 |
| WP52 | No longer available | #1 |
| WP54 | No longer available | #1 |
| WP55 | No longer available | #1 |
| WP6001 | No longer available | #1 |
| WP6011 | WP6211 | #5 |
| WP6012 | WP6212 | #5 |
| WP6020 | No longer available | #1 |
| WP6023 | No longer available | #1 |
| WP6040 | No longer available | #1 |
| WP6101 | WP6201 | #5 |
| WP6111 | WP6211 | #5 |
| WP6120 | No longer available | #1 |
| WP1233 | No longer available | #1 |
| WP1253LP | XL3025A | #2 |
| XLT2300NF | XL3300A | #5 |
| 1253 | No longer available | #1 |
| 1253LP | XL3025A | #2 |

FOOTNOTES

#1. No longer available; treat as new application.
#2. Hp ratings slightly different. Example: MM51 is designed for 1/4 Hp and less; MM2311C is designed for 1/8 Hp and less.
#3. Requires heat sink attached to the control or equivalent Hp ratings.
#4. For reversible application. If unidirectional, substitute MM21151C or C4XL3025.
#5. Footprint is exact.

| PART # | DESCRIPTION | PGS |
|---|---|---|
| 032-0020 | Brake Resistor | 92 |
| 032-0033 | Brake Resistor | 92 |
| 032-0043 | Brake Resistor | 92 |
| 032-0060 | Brake Resistor | 92 |
| 032-0062 | Brake Resistor | 92 |
| 032-0076 | Brake Resistor | 92 |
| 035-0006 | Brackets, 2 required | 92 |
| 035-0007 | Left-side bracket | 92 |
| 035-0008 | Right-side bracket | 92 |
| 050-0018 | AC Line Fuse | 91 |
| 050-0019 | AC Line Fuse | 91 |
| 050-0021 | AC Line Fuse | 91 |
| 050-0024 | AC Line Fuse | 91 |
| 050-0026 | Field Supply Fuse | 91 |
| 050-0074 | Pico Fuse | 91 |
| 080-0009 | AC Power, RUN/STOP/FWD/REV | 91 |
| 080-0027 | RUN/BRAKE and FWD/REV | 91 |
| 080-0030 | FWD/BRAKE and REV | 91 |
| 10EP1 | Reduces control noise | 92 |
| 110-0038 | Dial | 91 |
| 134-0046 | D89 male/female serial cable | 91 |
| 140-0009 | Knob | 91 |
| 155-0074 | Clear NEMA 4 Cover | 92 |
| 155-0075 | Clear NEMA 4 Cover | 92 |
| 200-0364 | Hall effect | 91 |
| 200-0386A | Limit Switch Logic Board - Open Chassis | 90 |
| 200-0416 | RG Isolation Adder Board | 90 |
| 200-0417 | RG Isolation Adder Board | 90 |
| 200-0418 | RG Isolation Adder Board | 90 |
| 201-0024 | Inhibit Plug | 91 |
| 201-0079 | Inhibit Plug | 91 |
| 202-0001 | Pot Kit | 92 |
| 202-0003 | Pot Kit | 92 |
| 202-0005 | Pot Kit | 92 |
| 202-0014 | Mounting Kit | 92 |
| 202-0056 | Pot Kit | 92 |
| 202-0112 | Pot Kit | 92 |
| 20VDK1 | Reduces control noise | 92 |
| 20VR1 | Reduces control noise | 92 |
| 20VV1 | Reduces control noise | 92 |
| 211-0001 | Magnetic Pickup | 91 |
| 211-0006 | Magnetic Pickup | 91 |
| 211-0010 | Magnetic Pickup | 91 |
| 211-0038 | Magnetic Pickup | 91 |
| 220-0048 | Bezel and lens | 92 |
| 220-0049 | Blank bezel and lens | 92 |
| 220-0051 | Bezel and lens | 92 |
| 221-0042 | Mounting Bracket | 92 |
| 221-0991 | Mounting Bracket | 95 |
| 221-0992 | Mounting Bracket | 95 |
| 221-0993 | Mounting Bracket | 95 |
| 221-0994 | Mounting Bracket | 95 |
| 221-0996 | Mounting Bracket | 95 |
| 221-0997 | Mounting Bracket | 95 |
| 223-0159 | Heat Sink | 91 |
| 223-0174 | Heat Sink | 91 |
| 223-0235 | Heat Sink | 91 |
| 223-0269 | Heat Sink | 91 |
| 223-0271 | Heat Sink | 91 |
| 230-0110 | Transformer | 91 |
| 504-36-041B | Non-geared motor | 38 |
| 504-36-042B | Non-geared motor | 38 |
| 504-36-043B | Non-geared motor | 38 |
| 506-06-131 | Non-geared motor | 38 |
| 506-07-027 | Non-geared motor | 38 |
| 506-07-028 | Non-geared motor | 38 |
| 506-07-029 | Non-geared motor | 38 |
| 506-07-030 | Non-geared motor | 38 |
| 506-07-038 | Non-geared motor | 38 |
| 506-07-040 | Non-geared motor | 38 |
| 506-20-001 | 3-phase AC motor | 61 |
| 506-20-002 | 3-phase AC motor | 61 |
| 506-21-001 | 3-phase AC motor | 61 |
| 506-21-002 | 3-phase AC motor | 61 |
| 506-21-003 | 3-phase AC motor | 61 |
| 506-21-004 | 3-phase AC motor | 61 |
| 506-21-005 | 3-phase AC motor | 61 |
| 506-21-006 | 3-phase AC motor | 61 |
| 506-21-007 | 3-phase AC motor | 61 |
| 506-21-008 | 3-phase AC motor | 61 |
| 506-21-009 | 3-phase AC motor | 61 |
| 506-22-001 | 3-phase AC motor | 61 |
| 506-22-002 | 3-phase AC motor | 61 |
| 506-23-001 | 3-phase AC motor | 61 |
| 506-23-002 | 3-phase AC motor | 61 |
| 506-23-003 | 3-phase AC motor | 61 |
| 506-23-004 | 3-phase AC motor | 61 |
| 506-23-005 | 3-phase AC motor | 61 |
| 506-23-006 | 3-phase AC motor | 61 |
| 506-23-007 | 3-phase AC motor | 61 |
| 506-23-008 | 3-phase AC motor | 61 |
| 506-23-009 | 3-phase AC motor | 61 |
| 506-24-001 | 3-phase AC motor | 61 |
| 506-25-001 | 3-phase AC motor | 61 |
| 506-25-002 | 3-phase AC motor | 61 |
| 506-36-038 | Non-geared motor | 38 |
| 506-36-039 | Non-geared motor | 38 |
| 506-36-131 | Non-geared motor | 38 |
| 506-36-140 | Non-geared motor | 38 |
| 506-37-029 | Non-geared motor | 38 |
| 506-37-035 | Non-geared motor | 38 |
| 507-01-105 | In-line Geared Motor | 39 |
| 507-01-106 | In-line Geared Motor | 39 |
| 507-01-107 | In-line Geared Motor | 39 |
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| 507-01-127 | In-line Geared Motor | 39 |
| 507-01-128 | In-line Geared Motor | 39 |
| 507-01-129 | In-line Geared Motor | 39 |
| 507-01-130 | In-line Geared Motor | 39 |
| 507-01-131 | In-line Geared Motor | 39 |
| 507-01-132 | In-line Geared Motor | 39 |
| 507-02-002 | Right-Angle Geared Motor | 40 |
| 507-02-003 | Right-Angle Geared Motor | 40 |
| 507-02-125 | Right-Angle Geared Motor | 40 |
| 507-02-126 | Right-Angle Geared Motor | 40 |
| 507-02-128 | Right-Angle Geared Motor | 40 |
| 507-02-135 | Right-Angle Geared Motor | 40 |
| 507-02-136 | Right-Angle Geared Motor | 40 |
| 507-02-138 | Right-Angle Geared Motor | 40 |
| 507-02-139 | Right-Angle Geared Motor | 40 |
| 507-02-140 | Right-Angle Geared Motor | 40 |
| 510-09-001 | In-line Geared Motor | 39 |
| 510-09-002 | In-line Geared Motor | 39 |
| 510-09-003 | In-line Geared Motor | 39 |
| 510-09-004 | In-line Geared Motor | 39 |
| 510-09-005 | In-line Geared Motor | 39 |


*Open Chassis



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| PART # | DESCRIPTION | PGS |
|---|---|---|
| 510-09-006 | In-line Geared Motor | 39 |
| 510-09-007 | In-line Geared Motor | 39 |
| 510-09-008 | In-line Geared Motor | 39 |
| 510-09-009 | In-line Geared Motor | 39 |
| 510-09-011 | In-line Geared Motor | 39 |
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| 510-09-016 | In-line Geared Motor | 39 |
| 510-09-017 | In-line Geared Motor | 39 |
| 510-09-018 | In-line Geared Motor | 39 |
| 510-09-019 | In-line Geared Motor | 39 |
| 510-09-020 | In-line Geared Motor | 39 |
| 510-09-021 | In-line Geared Motor | 39 |
| 510-09-022 | In-line Geared Motor | 39 |
| 510-09-025 | n-line Geared Motor | 39 |
| 510-09-029 | In-line Geared Motor | 39 |
| 510-09-031 | In-line Geared Motor | 39 |
| 510-09-032 | In-line Geared Motor | 39 |
| 510-09-033 | In-line Geared Motor | 39 |
| 510-09-035 | In-line Geared Motor | 39 |
| 510-09-037 | In-line Geared Motor | 39 |
| 510-09-038 | In-line Geared Motor | 39 |
| 510-09-041 | In-line Geared Motor | 39 |
| 510-09-043 | In-line Geared Motor | 39 |
| 510-09-045 | In-line Geared Motor | 39 |
| 510-18-002 | In-line Geared Motor | 39 |
| 510-18-003 | In-line Geared Motor | 39 |
| 510-18-007 | In-line Geared Motor | 39 |
| 510-18-008 | In-line Geared Motor | 39 |
| 510-18-018 | In-line Geared Motor | 39 |
| 510-18-021 | In-line Geared Motor | 39 |
| 510-18-023 | In-line Geared Motor | 39 |
| 510-18-025 | In-line Geared Motor | 39 |
| 510-18-027 | In-line Geared Motor | 39 |
| 511-09-047 | Right-Angle Geared Motor | 40 |
| 511-09-048 | Right-Angle Geared Motor | 40 |
| 511-09-049 | Right-Angle Geared Motor | 40 |
| 511-09-056 | Right-Angle Geared Motor | 40 |
| 511-09-057 | Right-Angle Geared Motor | 40 |
| 511-09-058 | Right-Angle Geared Motor | 40 |
| 511-09-060 | Right-Angle Geared Motor | 40 |
| 511-09-061 | Right-Angle Geared Motor | 40 |
| 511-09-063 | Right-Angle Geared Motor | 40 |
| 511-09-064 | Right-Angle Geared Motor | 40 |
| 511-09-065 | Right-Angle Geared Motor | 40 |
| 511-18-051 | Right-Angle Geared Motor | 40 |
| 511-18-054 | Right-Angle Geared Motor | 40 |
| 511-18-057 | Right-Angle Geared Motor | 40 |
| 511-18-059 | Right-Angle Geared Motor | 40 |
| 518-41-004 | NEMA 17 Gearhead | 84 |
| 518-41-005 | NEMA 17 Gearhead | 84 |
| 518-41-007 | NEMA 17 Gearhead | 84 |
| 518-41-010 | NEMA 17 Gearhead | 84 |
| 518-41-016 | NEMA 17 Gearhead | 84 |
| 518-41-028 | NEMA 17 Gearhead | 84 |
| 518-41-040 | NEMA 17 Gearhead | 84 |
| 518-41-049 | NEMA 17 Gearhead | 84 |
| 518-41-070 | NEMA 17 Gearhead | 84 |
| 518-41-100 | NEMA 17 Gearhead | 84 |
| 518-42-004 | NEMA 23 Gearhead | 84 |
| 518-42-005 | NEMA 23 Gearhead | 84 |
| 518-42-007 | NEMA 23 Gearhead | 84 |
| 518-42-010 | NEMA 23 Gearhead | 84 |

| PART # | DESCRIPTION | PGS |
|---|---|---|
| 518-42-016 | NEMA 23 Gearhead | 84 |
| 518-42-028 | NEMA 23 Gearhead | 84 |
| 518-42-040 | NEMA 23 Gearhead | 84 |
| 518-42-049 | NEMA 23 Gearhead | 84 |
| 518-42-070 | NEMA 23 Gearhead | 84 |
| 518-42-100 | NEMA 23 Gearhead | 84 |
| 518-43-004 | NEMA 34 Gearhead | 85 |
| 518-43-005 | NEMA 34 Gearhead | 85 |
| 518-43-007 | NEMA 34 Gearhead | 85 |
| 518-43-010 | NEMA 34 Gearhead | 85 |
| 518-43-016 | NEMA 34 Gearhead | 85 |
| 518-43-028 | NEMA 34 Gearhead | 85 |
| 518-43-040 | NEMA 34 Gearhead | 85 |
| 518-43-049 | NEMA 34 Gearhead | 85 |
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| 518-44-005 | NEMA 42 Gearhead | 85 |
| 518-44-007 | NEMA 42 Gearhead | 85 |
| 518-44-010 | NEMA 42 Gearhead | 85 |
| 518-44-016 | NEMA 42 Gearhead | 85 |
| 518-44-028 | NEMA 42 Gearhead | 85 |
| 518-44-040 | NEMA 42 Gearhead | 85 |
| 518-44-049 | NEMA 42 Gearhead | 85 |
| 530-XX-210 | Brushless motor | 73 |
| 530-XX-210N | Brushless motor | 73 |
| 530-XX-212 | Brushless motor | 73 |
| 530-XX-230 | Brushless motor | 73 |
| 530-XX-230N | Brushless motor | 73 |
| 530-XX-270 | Brushless motor | 73 |
| 530-XX-270N | Brushless motor | 73 |
| 530-XX-272 | Brushless motor | 73 |
| 530-XX-272N | Brushless motor | 73 |
| 530-XX-312 | Brushless motor | 73 |
| 530-XX-312N | Brushless motor | 73 |
| 530-XX-330 | Brushless motor | 73 |
| 530-XX-330N | Brushless motor | 73 |
| 530-XX-332 | Brushless motor | 73 |
| 530-XX-332N | Brushless motor | 73 |
| 530-XX-334 | Brushless motor | 73 |
| 530-XX-334N | Brushless motor | 73 |
| 530-XX-352 | Brushless motor | 73 |
| 530-XX-352N | Brushless motor | 73 |
| 530-XX-354 | Brushless motor | 73 |
| 530-XX-354N | Brushless motor | 73 |
| 530-XX-372 | Brushless motor | 73 |
| 530-XX-372N | Brushless motor | 73 |
| 530-XX-374 | Brushless motor | 73 |
| 530-XX-374N | Brushless motor | 73 |
| 530-XX-412 | Brushless motor | 73 |
| 530-XX-412N | Brushless motor | 73 |
| 530-XX-420 | Brushless motor | 73 |
| 530-XX-420N | Brushless motor | 73 |
| 530-XX-422 | Brushless motor | 73 |
| 530-XX-422N | Brushless motor | 73 |
| 530-XX-426 | Brushless motor | 73 |
| 530-XX-426N | Brushless motor | 73 |
| 530-XX-430 | Brushless motor | 73 |
| 530-XX-430N | Brushless motor | 73 |
| 530-XX-432 | Brushless motor | 73 |
| 530-XX-432N | Brushless motor | 73 |
| 5VR1 | Reduces control noise | 92 |
| 6EP1 | Reduces control noise | 92 |
| 6VDK1 | Reduces control noise | 92 |

| PART # | DESCRIPTION | PGS |
|---|---|---|
| 6VSK1 | Reduces control noise | 92 |
| 6VV1 | Reduces incoming noise | 92 |
| 840-001 | AC100/200 din rail A | 94 |
| 840-002 | AC100/200 din rail B | 94 |
| 840-003 | AC100/200 din rail C | 94 |
| 840-004 | AC200 remote keypad | 94 |
| 840-005 | EPM Programmer | 94 |
| 840-006 | 10 EPM Modules | 94 |
| 840-009 | Remote Keypad with Gasket | 94 |
| 840-100 | AC100/200 .25-.5HpDB;208/240 | 93 |
| 840-101 | AC100/200 1-1.5Hp DB;208/240 | 93 |
| 840-102 | AC100/200 2-3Hp DB;208/24 | 93 |
| 840-103 | AC100/200 5Hp DB;208/240 | 93 |
| 840-104 | AC100/200 7.5Hp DB/208/240 | 93 |
| 840-105 | AC100/200 10Hp DB;208/240 | 93 |
| 840-106 | AC100/200 .25-.5HpDB;400/480 | 93 |
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| 840-108 | AC100/200 2-3Hp DB;400/480 | 93 |
| 840-109 | AC100/200 5Hp DB;400/480 | 93 |
| 840-110 | AC100/200 7.5Hp DB;400/480 | 93 |
| 840-111 | AC100/200 10Hp DB;400/480 | 93 |
| 840-112 | AC100/200 1-1.5Hp DB;480/590 | 93 |
| 840-113 | AC100/200 2-3Hp DB;480/590 | 93 |
| 840-114 | AC100/200 5Hp DB;480/590 | 93 |
| 840-115 | AC100/200 7.5Hp DB;480/590 | 93 |
| 840-116 | AC100/200 10Hp DB;480/590 | 93 |
| 840-117 | AC100/AC200 15-25Hp DB module | 93 |
| 840-118 | AC100/AC200 15-25Hp DB module | 93 |
| 840-119 | AC100/AC200 15-25Hp DB module | 93 |
| 841-001 | 2.5' Remote keypd cable | 94 |
| 841-002 | 5' Remote keypd cable | 94 |
| 841-003 | 10' Remote keypad cable | 94 |
| 841-004 | AC300 2.5' Remote keypad kit | 94 |
| 841-005 | AC300 5' Remote keypd kit | 94 |
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| 841-008 | AC400 5' Remote keypad kit | 94 |
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| 841-031 | AC300 DB Kits | 93 |
| 841-032 | AC300 DB & add'l Form C Relays | 93 |
| 841-033 | AC300 DB & add'l Form C Relays | 93 |
| 841-050 | AC300 DB & add'l Form C Relays | 94 |
| 841-051 | AC300 DB & add'l Form C Relays | 94 |
| 841-052 | AC300 DB & add'l Form C Relays | 94 |
| 841-100 | AC300 .5Hp DB res. | 93 |
| 841-101 | AC300 1-2Hp DB res. | 93 |
| 841-102 | AC300 2Hp DB res. | 93 |
| 841-103 | AC300 3Hp DB res. | 93 |
| 841-104 | AC300 3Hp DB res. | 93 |
| 841-105 | AC300 5Hp DB res. | 93 |
| 841-106 | AC300 7.5&10Hp DB | 93 |
| 841-107 | AC300 7.5&10Hp DB | 93 |
| 841-108 | AC300 15&20Hp DB res | 93 |
| 841-109 | AC300 15&20Hp DB res | 93 |
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| 841-111 | AC300 25&30Hp DB res | 93 |
| 841-112 | AC300 40Hp DB res. | 93 |
| 841-113 | AC300 40Hp DB res. | 93 |
| 841-114 | AC300 50&60Hp DB res | 93 |
| 841-115 | AC300 50&60Hp DB res | 93 |
| 844-400 | 10A, 1PH CE filter | 94 |
| 844-401 | 20A, 1PH CE filter | 94 |
| 844-402 | 8A, 3PH CE filter | 94 |
| 844-403 | 10A, 3PH CE filter | 94 |
| 844-404 | 20A, 3PH CE filter | 94 |
| "F" suffix | AC-6 volt supply cbl | 94 |
| "V" suffix | RS232-RS485 convertr | 94 |
| AC211S-0.75 | Isolated PWM AC IP20 | 58 |
| AC211S-1.1 | Isolated PWM AC IP20 | 58 |
| AC212B-0.2 | Isolated PWM AC IP20 | 58 |
| AC212B-0.4 | Isolated PWM AC IP20 | 58 |
| AC212B-0.75 | Isolated PWM AC IP20 | 58 |
| AC212B-1.1 | Isolated PWM AC IP20 | 58 |
| AC212B-1.5 | Isolated PWM AC IP20 | 58 |
| AC212B-2.2 | Isolated PWM AC IP20 | 58 |
| AC212B-3.7 | Isolated PWM AC IP20 | 58 |
| AC212T-0.75 | Isolated PWM AC IP20 | 58 |
| AC212T-1.1 | Isolated PWM AC IP20 | 58 |
| AC212T-1.5 | Isolated PWM AC IP20 | 58 |
| AC212T-11 | Isolated PWM AC IP20 | 58 |
| AC212T-15 | Isolated PWM AC IP20 | 58 |
| AC212T-2.2 | Isolated PWM AC IP20 | 58 |
| AC212T-3.7 | Isolated PWM AC IP20 | 58 |
| AC212T-5.5 | Isolated PWM AC IP20 | 58 |
| AC212T-7.5 | Isolated PWM AC IP20 | 58 |
| AC214T-0.4 | Isolated PWM AC IP20 | 58 |
| AC214T-0.75 | Isolated PWM AC IP20 | 58 |
| AC214T-1.1 | Isolated PWM AC IP20 | 58 |
| AC214T-1.5 | Isolated PWM AC IP20 | 58 |
| AC214T-11 | Isolated PWM AC IP20 | 58 |
| AC214T-15 | Isolated PWM AC IP20 | 58 |
| AC214T-18.5 | Isolated PWM AC IP20 | 58 |
| AC214T-2.2 | Isolated PWM AC IP20 | 58 |
| AC214T-3.7 | Isolated PWM AC IP20 | 58 |
| AC214T-5.5 | Isolated PWM AC IP20 | 58 |
| AC214T-7.5 | Isolated PWM AC IP20 | 58 |
| AC215T-0.75 | Isolated PWM AC IP20 | 58 |
| AC215T-1.5 | Isolated PWM AC IP20 | 58 |
| AC215T-11 | Isolated PWM AC IP20 | 58 |
| AC215T-15 | Isolated PWM AC IP20 | 58 |
| AC215T-18.5 | Isolated PWM AC IP20 | 58 |
| AC215T-2.2 | Isolated PWM AC IP2 | 58 |
| AC215T-3.7 | Isolated PWM AC IP20 | 58 |
| AC215T-5.5 | Isolated PWM AC IP20 | 58 |
| AC215T-7.5 | Isolated PWM AC IP20 | 58 |
| AC321S-0.2 | Isolated PWM AC NEMA 1 | 60 |
| AC321S-0.4 | Isolated PWM AC NEMA 1 | 60 |
| AC321S-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC321S-1.1 | Isolated PWM AC NEMA 1 | 60 |
| AC322S-0.4 | Isolated PWM AC NEMA 1 | 60 |
| AC322S-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC322S-1.1 | Isolated PWM AC NEMA 1 | 60 |
| AC322S-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC322S-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-0.4 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-1.1 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-11 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-15 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-18.5 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-22 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-3.7 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-5.5 | Isolated PWM AC NEMA 1 | 60 |
| AC322T-7.5 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-0.75 | Isolated PWM AC NEMA 1 | 60 |

| PART # | DESCRIPTION | PGS |
|---|---|---|
| AC324T-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-11 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-15 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-18.5 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-22 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-3.7 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-30 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-37 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-45 | Isolated PWM AC NEMA 1 | 60 |
| AC324T-5.5 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-11 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-15 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-18.5 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-22 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-3.7 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-30 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-37 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-45 | Isolated PWM AC NEMA 1 | 60 |
| AC325T-5.5 | Isolated PWM AC NEMA 1 | 60 |
| AC331S-0.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC331S-0.4 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC331S-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC331S-1.1 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332S-0.4 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332S-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332S-1.1 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332S-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332S-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-0.4 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-1.1 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-11 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-3.7 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-5.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC332T-7.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC334T-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC334T-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC334T-11 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC334T-15 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC334T-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC334T-3.7 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC334T-5.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC335T-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC335T-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC335T-11 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC335T-15 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC335T-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC335T-3.7 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC335T-5.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC342T-15 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC344T-18.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC344T-22 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC345T-18.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC345T-22 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC351S-0.2 | Isolated PWM AC NEMA 4X | 60 |
| AC351S-0.4 | Isolated PWM AC NEMA 4X | 60 |
| AC351S-0.75 | Isolated PWM AC NEMA 4X | 60 |
| AC351S-1.1 | Isolated PWM AC NEMA 4X | 60 |

| PART # | DESCRIPTION | PGS |
|---|---|---|
| AC352S-0.4 | Isolated PWM AC NEMA 4X | 60 |
| AC352S-0.75 | Isolated PWM AC NEMA 4X | 60 |
| AC352S-1.1 | Isolated PWM AC NEMA 4X | 60 |
| AC352S-1.5 | Isolated PWM AC NEMA 4X | 60 |
| AC352S-2.2 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-0.4 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-0.75 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-1.1 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-1.5 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-11 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-2.2 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-3.7 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-5.5 | Isolated PWM AC NEMA 4X | 60 |
| AC352T-7.5 | Isolated PWM AC NEMA 4X | 60 |
| AC354T-0.75 | Isolated PWM AC NEMA 4X | 60 |
| AC354T-1.5 | Isolated PWM AC NEMA 4X | 60 |
| AC354T-11 | Isolated PWM AC NEMA 4X | 60 |
| AC354T-15 | Isolated PWM AC NEMA 4X | 60 |
| AC354T-2.2 | Isolated PWM AC NEMA 4X | 60 |
| AC354T-3.7 | Isolated PWM AC NEMA 4X | 60 |
| AC354T-5.5 | Isolated PWM AC NEMA 4X | 60 |
| AC355T-0.75 | Isolated PWM AC NEMA 4X | 60 |
| AC355T-1.5 | Isolated PWM AC NEMA 4X | 60 |
| AC355T-11 | Isolated PWM AC NEMA 4X | 60 |
| AC355T-15 | Isolated PWM AC NEMA 4X | 60 |
| AC355T-2.2 | Isolated PWM AC NEMA 4X | 60 |
| AC355T-3.7 | Isolated PWM AC NEMA 4X | 60 |
| AC355T-5.5 | Isolated PWM AC NEMA 4X | 60 |
| AC421S-0.2 | Isolated PWM AC NEMA 1 | 60 |
| AC421S-0.4 | Isolated PWM AC NEMA 1 | 60 |
| AC421S-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC421S-1.1 | Isolated PWM AC NEMA 1 | 60 |
| AC422S-0.4 | Isolated PWM AC NEMA 1 | 60 |
| AC422S-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC422S-1.1 | Isolated PWM AC NEMA 1 | 60 |
| AC422S-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC422S-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-0.4 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-1.1 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-11 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-15 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-18.5 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-22 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-3.7 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-5.5 | Isolated PWM AC NEMA 1 | 60 |
| AC422T-7.5 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-11 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-15 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-18.5 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-22 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-3.7 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-30 | Isolated PWM AC NEMA 1 | 60 |
| AC424T-37 | Isolated PWM AC NEMA | 60 |
| AC424T-45 | Isolated PWM AC NEMA | 60 |
| AC424T-5.5 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-0.75 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-1.5 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-11 | Isolated PWM AC NEMA 1 | 60 |

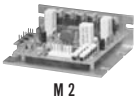
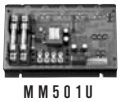
| PART # | DESCRIPTION | PGS |
|---|---|---|
| AC425T-15 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-18.5 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-2.2 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-22 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-3.7 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-30 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-37 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-45 | Isolated PWM AC NEMA 1 | 60 |
| AC425T-5.5 | Isolated PWM AC NEMA 1 | 60 |
| AC431S-0.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC431S-0.4 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC431S-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC431S-1.1 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432S-0.4 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432S-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432S-1.1 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432S-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432S-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-0.4 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-1.1 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-11 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-3.7 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-5.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC432T-7.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC434T-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC434T-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC434T-11 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC434T-15 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC434T-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC434T-3.7 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC434T-5.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC435T-0.75 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC435T-1.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC435T-11 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC435T-15 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC435T-2.2 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC435T-3.7 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC435T-5.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC442T-15 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC444T-18.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC444T-22 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC445T-18.5 | Isolated PWM AC NEMA 4 & 12 | 60 |
| AC445T-22 | Isolated PWM AC NEMA 4 & 12 | 60 |
| ACM110S-0.25 | PWM AC IP20 | 58 |
| ACM110S-0.4 | PWM AC IP20 | 58 |
| ACM110S-0.75 | PWM AC IP20 | 58 |
| ACM110S-1.1 | PWM AC IP20 | 58 |
| ACM112S-0.25 | PWM AC IP20 | 58 |
| ACM112S-0.4 | PWM AC IP20 | 58 |
| ACM112S-0.55 | PWM AC IP20 | 58 |
| ACM112S-0.75 | PWM AC IP20 | 58 |
| ACM112S-1.1 | PWM AC IP20 | 58 |
| ACM112S-1.5 | PWM AC IP20 | 58 |
| ACM112S-2.2 | PWM AC IP20 | 58 |
| ACM112T-0.4 | PWM AC IP20 | 58 |
| ACM112T-0.75 | PWM AC IP20 | 58 |
| ACM112T-1.1 | PWM AC IP20 | 58 |
| ACM112T-1.5 | PWM AC IP20 | 58 |
| ACM112T-2.2 | PWM AC IP20 | 58 |
| ACM112T-3.7 | PWM AC IP20 | 58 |
| ACM114T-0.4 | PWM AC IP20 | 58 |

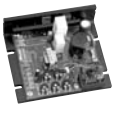
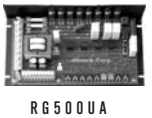
| PART # | DESCRIPTION | PGS |
|---|---|---|
| ACM114T-0.75 | PWM AC IP20 | 58 |
| ACM114T-1.1 | PWM AC IP20 | 58 |
| ACM114T-1.5 | PWM AC IP20 | 58 |
| ACM114T-2.2 | PWM AC IP20 | 58 |
| ACM114T-3.7 | PWM AC IP20 | 58 |
| BOSS04AC-1Q | Brushless, Open Chassis | 69 |
| BOSS04-D240AC-4Q | Brushless, Regen Open Chassis | 70 |
| BOSS04-D240AC-CM | Brushless, Regen Open Chassis | 71 |
| BOSS08AC-1Q | Brushless, Open Chassis | 69 |
| BOSS08-D240AC-4Q | Brushless, Regen Open Chassis | 70 |
| BOSS08-D240AC-CM | Brushless, Regen Open Chassis | 71 |
| BOSS15-115AC-4Q | Brushless, Regen Open Chassis | 70 |
| BOSS15-115AC-CM | Brushless, Regen Open Chassis | 71 |
| BOSS15AC-1Q | Brushless, Open Chassis | 69 |
| BOSSDB-115 | 115V, BOSS 4Q Regen Circuit | 92 |
| BOSSDB-230 | 230V, BOSS 4Q Regen Circuit | 92 |
| C1RGD03-D230AC | SCR Digital Regen NEMA 1 Enclosure | 36 |
| C1RGD10-D230AC | SCR Digital Regen NEMA 1 Enclosure | 36 |
| C1XP01-115AC-A | PWM NEMA 1 Enclosure | 23 |
| C1XP03-115AC-A | PWM NEMA 1 Enclosure | 23 |
| C4XL3025 | PWM NEMA 4X Enclosure | 24 |
| C4XL3200A | PWM NEMA 4X Enclosure | 24 |
| CE04XL | Reduces incoming noise | 92 |
| CE15XL | Reduces incoming noise | 92 |
| CE20MM | Reduces control noise | 92 |
| CE20RG | Reduces control noise | 92 |
| CE20XL | Reduces incoming noise | 92 |
| CE24PWM | Reduces incoming noise | 92 |
| CE4MM | Reduces control noise | 92 |
| CE4RG | Reduces control noise | 92 |
| DC16-12/24 | DC to DC Open Chassis | 19 |
| DC5004Q-36/48 | PWM DC to DC Enclosed | 18 |
| DC60-12/24 | PWM DC to DC Open Chassis | 19 |
| DC60-36/48 | PWM DC to DC Open Chassis | 19 |
| DLC600 | Digital Control | 87 |
| DT-2R-A7 | Limit Switch | 91 |
| DT-2RV212-A7 | Limit Switch | 91 |
| LV01-24AC | PWM DC Low Voltage | 21 |
| LV02-24AC | PWM DC Low Voltage | 21 |
| LV02-24DC | PWM DC Low Voltage | 21 |
| LVBL02-24AC/DC | Brushless Low Voltage Open Chassis | 68 |
| LVBL06-24AC/DC | Brushless Low Voltage Open Chassis | 68 |
| M1 | SCR Open Chassis | 4 |
| M2 | SCR Open Chassis | 5 |
| MAC05-115AC | AC Open Chassis | 54 |
| MAC05-115AC-PCM | AC Isolated Open Chassis | 54 |
| MAC05-D240AC | AC Open Chassis | 54 |
| MAC05-D240AC-PCM | AC Isolated Open Chassis | 54 |
| MAC08-115AC | AC Open Chassis | 54 |
| MAC08-115AC-PCM | AC Isolated Open Chassis | 54 |
| MAC08-D240AC | AC Open Chassis | 54 |
| MAC08-D240AC-PCM | AC Isolated Open Chassis | 54 |
| MC10 | SCR NEMA 4X Enclosure | 11 |
| MC10-PCM | Isolated NEMA 4X Enclosure | 11 |
| MC10-R | NEMA 4X Enclosure Reversing | 11 |
| MM03-115AC-PCM | SCR Isolated Open Chassis | 8 |
| MM03-230AC-PCM | SCR Isolated Open Chassis | 8 |
| MM10-115AC-PCM | SCR Isolated Open Chassis | 8 |
| MM10-230AC-PCM | SCR Isolated Open Chassis | 8 |
| MM21151C | SCR Filtered NEMA 1 Enclosure | 10 |
| MM21251C | SCR Filtered NEMA 1 Enclosure | 10 |
| MM23001C | SCR Open Chassis | 2 |
| MM23002D | SCR Open Chassis | 3 |
| MM23011C | SCR Open Chassis | 2 |

| PART # | DESCRIPTION | PGS |
|---|---|---|
| MM23012D | SCR Open Chassis | 3 |
| MM23101C | SCR NEMA 1 Enclosure | 10 |
| MM23102D | SCR NEMA 1 Enclosure | 3 |
| MM23112D | SCR NEMA 1 Enclosure | 3 |
| MM23201C | SCR NEMA 1 Enclosure | 10 |
| MM23202D | SCR NEMA 1 Enclosure | 3 |
| MM23212D | SCR NEMA 1 Enclosure | 3 |
| MM23401C | SCR NEMA 4X Enclosure | 12 |
| MM23402D | SCR NEMA 4X Enclosure | 3 |
| MM23411C | SCR NEMA 4X Enclosure | 12 |
| MM23412D | SCR NEMA 4X Enclosure | 3 |
| MM301U | SCR Isolated Open Chassis | 7 |
| MM311U | SCR Isolated Open Chassis | 7 |
| MM31700B | SCR Open Chassis | 9 |
| MM31701B | SCR Open Chassis | 9 |
| MM31750B | SCR Open Chassis | 9 |
| MM31751B | SCR Open Chassis | 9 |
| MM501U | SCR Isolated Open Chassis | 7 |
| MMBOSS05-24DC-1Q | PWM Brushless Open Chassis | 72 |
| MMRG30U | SCR Regen Open Chassis | 28 |
| MMRG30U-PCM | SCR Isolated Regen Open Chassis | 28 |
| MMRG31U | SCR Regen Open Chassis | 28 |
| MMRG31U-PCM | SCR Isolated Regen Open Chassis | 28 |
| MMRG40U | SCR Regen Open Chassis | 28 |
| MMRG40U-PCM | SCR Isolated Regen Open Chassis | 28 |
| MMRGD03-D230AC | SCR Digital Regen Open Chassis | 29 |
| MMRGD03-D230AC-PCM | SCR Isolated Digital Regen Open Chassis | 29 |
| MMRGD10-D230AC | SCR Digital Regen Open Chassis | 29 |
| MMRGD10-D230AC-PCM | SCR Isolated Digital Regen Open Chassis | 29 |
| MMXL02-D240AC | PWM DC Open Chassis | 14 |
| MMXL02-D240AC-PCM | PWM Isolated DC Open Chassis | 14 |
| MMXL05-D240AC | PWM DC Open Chassis | 14 |
| MMXL05-D240AC-PCM | PWM Isolated DC Open Chassis | 14 |
| MMXL10-D240AC | PWM DC Open Chassis | 14 |
| MMXL10-D240AC-PCM | PWM Isolated DC Open Chassis | 14 |
| NRG02-D240AC-2Q | PWM Regen Open Chassis | 33 |
| NRG02-D240AC-4Q | PWM Regen Open Chassis | 32 |
| NRG05-D240AC-2Q | PWM Regen Open Chassis | 33 |
| NRG05-D240AC-4Q | PWM Regen Open Chassis | 32 |
| NRG10-115AC-2Q | PWM Regen Open Chassis | 33 |
| NRG10-115AC-4Q | PWM Regen Open Chassis | 32 |
| PCM21000A | SCR Isolated Open Chassis | 6 |
| PCM21010A | SCR Isolated Open Chassis | 6 |
| PCM22000A | SCR Isolated Open Chassis | 6 |
| PCM23001A | SCR Isolated Open Chassis | 6 |
| PCM23401A | SCR Isolated NEMA 4X Enclosure | 13 |
| PCM23411A | SCR Isolated NEMA 4X Enclosure | 13 |
| PCM4 | Isolation Card | 90 |
| PCMXP02-115AC | PWM Isolated Open Chassis | 22 |
| PCMXP05-115AC | PWM Isolated Open Chassis | 22 |
| PCMXP10-115AC | PWM Isolated Open Chassis | 22 |
| PK23 | Encoder | 89 |
| PK24 | Encoder | 89 |
| RG25U | SCR Regen Open Chassis | 31 |
| RG500A | SCR Regen NEMA 4X Enclosure | 34 |
| RG500UA | SCR Regen Open Chassis | 25 |
| RG500UA-PCM | SCR Isolated Regen Open Chassis | 25 |
| RG501A | SCR Regen NEMA 4X Enclosure | 35 |
| RG510A | SCR Regen NEMA 4X Enclosure | 34 |
| RG510UA | SCR Regen Open Chassis | 25 |
| RG510UA-PCM | SCR Isolated Regen Open Chassis | 25 |
| RG511A | SCR Regen NEMA 4X Enclosure | 35 |
| RG51UA | SCR Regen Open Chassis | 31 |
| RG5500U | SCR Isolated Regen Open Chassis | 26 |

| PART # | DESCRIPTION | PGS |
|---|---|---|
| RG60U | SCR Regen Open Chassis | 27 |
| RG60U-PCM | SCR Isolated Regen Open Chassis | 27 |
| RG60U-T | SCR Regen Open Chassis | 27 |
| RGT300U | SCR Regen Open Chassis | 30 |
| RGT300U-PCM | Isolated Regen Open Chassis | 30 |
| RGT310U | SCR Regen Open Chassis | 30 |
| RGT310U-PCM | SCR Isolated Regen Open Chassis | 30 |
| RGT400U | SCR Regen Open Chassis | 30 |
| RGT400U-PCM | SCR Isolated Regen Open Chassis | 30 |
| RR2KP-U-DC24V | General Purpose Relay | 91 |
| SR3P-05C | Relay socket | 91 |
| SR3P-06 | Relay socket | 91 |
| VFD01-230AC | PWM AC Open Chassis | 53 |
| VFD01-230AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD01-D230AC | PWM AC Open Chassis | 53 |
| VFD01-D230AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD02-115AC | PWM AC Open Chassis | 53 |
| VFD02-115AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD02-230AC | PWM AC Open Chassis | 53 |
| VFD02-230AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD02-D230AC | PWM AC Open Chassis | 53 |
| VFD02-D230AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD04-115AC | PWM AC Open Chassis | 53 |
| VFD04-115AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD04-230AC | PWM AC Open Chassis | 53 |
| VFD04-230AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD04-D230AC | PWM AC Open Chassis | 53 |
| VFD04-D230AC-PCM | PWM AC Isolated Open Chassis | 53 |
| VFD05-D230AC-PCM | PWM AC Isolated Open Chassis | 50 |
| VFDA4X04-D230AC-PCM | PWM AC Isolated NEMA 4X Enclosure | 51 |
| VFDF4X04-D230AC-PCM | PWM AC Isolated NEMA 4X Enclosure | 51 |
| VFDP4X04-D230AC-PCM | PWM AC Isolated NEMA 4X Enclosure | 52 |
| VT8-D230AC | Digital Display | 88 |
| XL3025A | PWM Open Chassis | 15 |
| XL3050A | PWM Open Chassis | 15 |
| XL3200A | PWM Open Chassis | 15 |
| XL3300A | PWM Open Chassis | 15 |
| XP01-115AC-SL | PWM Open Chassis | 17 |
| XP02-115AC | PWM Open Chassis | 16 |
| XP02-115AC-Q | PWM Open Chassis | 16 |
| XP03-115AC-SL | PWM Open Chassis | 17 |
| XP05-115AC | PWM Open Chassis | 16 |
| XP08-60DC | PWM Open Chassis | 20 |
| XP10-115AC | PWM Open Chassis | 16 |
| XP16-36/48DC | PWM DC to DC Open Chassis | 20 |
| XP32-12/24DC | PWM DC to DC Open Chassis | 20 |
| XP60-12/24DC | PWM DC to DC Open Chassis | 20 |

# Drives Description Index


| DRIVE | MODEL DESCRIPTION | PG. |
|---|---|---|
| MM23001C | The MM23000C Series are reliable, cost-effective dual voltage SCR Open Chassis drives for 1/20 to 1 Hp DC motors. These drives are an excellent solution for controlling permanent magnet or shunt wound DC motors in variable speed applications. | 2 |
| MM23002D | The MM23000D Series are reliable, cost-effective dual voltage SCR Open Chassis and Enclosure drives for 1/20 to 2 Hp DC motors. The MM23000D Series contains a user-selectable inhibit circuit so the user can adjust the function of the inhibit with jumper pins. The MM23002D can operate in either speed or torque control mode. | 3 |
| M1 | The M1 Series is a very compact drive rated up to 1/2hp (1hp with heatsink). The M1 has a chip that can be factory pre-programmed for custom trimmer pot ranges. The M1 includes an inhibit function, a jumper to calibrate for smaller motors (1/15 to 1/8 hp), six trimmer pots and a wide IR compensation range. Extremely compact size and programmability make the M1 perfect for both OEMs and Users. | 4 |
|  M2 | The M2 Series provides the power of two drives in one. Independently control two different DC motors in speed or torque control. In the speed control mode, you can run the two motors indepently or in ratio to each other. In ratio mode, the drive replaces two drives and a master/follower card too. The M2 drive is microprocessor based and can be customized without hardware changes. | 5 |
| PCM21000A | The PCM20000A Series are SCR Isolated Open Chassis drives for 1/20 to 2 Hp DC brushed motors. These drives integrate isolation allowing them to accept external analog process control signals. Users can operate the drives in manual mode using normal potentiometer operation or in signal mode where drive output is proportional to an external signal output. | 6 |
|  MM501U | The MM Series are dual voltage SCR Isolated Open Chassis drives for 1/20 to 5 Hp DC brushed motors. The MM Series have integrated isolation allowing them to precisely follow analog current or voltage signals from external devices or a potentiometer. The drives also contain built-in diagnostics and built-in fuse block. | 7 |
| MM03-115AC-PCM | SCR Isolated Open Chassis drives for 1/20 to 1 Hp DC brushed motors. The MM-PCM drives accept non-isolated voltage (0-10VDC) or current (4-20mA) signals coming from an in-plant process, PLC, motion controller, etc. to control speed. Quick connect terminal block for easy wiring. | 8 |
| MM31750B | The MM31700 Series are low cost SCR open chassis drives designed for OEMs. They control 1/50-1/8 Hp DC brush motors with minimal features resulting in a compact package. The drives are available with or without a mounted speed potentiometer. | 9 |
| MM23201C | The MM20000 Series are SCR NEMA 1 Enclosure drives for 1/20 to 2 Hp DC brushed motors. These drives have non-regenerative reversing and dynamic braking capability accessible through switches on the front of the enclosure. Six different units available. The NEMA 1 Enclosure protects the drive from accidental contact and falling objects. | 10 |
| Patriot | The Patriot Series provides a reliable, economical solution for controlling permanent magnet or shut-wound DC motors. NEMA 4X enlcosure, ideal for washdown applications and protection from contact. Reversing (-R) and isolated (-PCM) models also available. | 11 |
| MM23401C | The MM23400C Series are SRC NEMA 4X Enclosure drives for 1/20 to 2 Hp DC brushed motors. These stand alone drives contain a power neon light, a pre-mounted heatsink, a power switch and speed adjustment knob accessible from the front of the enclosure. Using full-wave rectification of the AC line input, these drives provide a 60:1 speed range. | 12 |
| PCM23401A | The PCM23400A Series are SRC Isolated NEMA 4X Enclosure drives for 1/20 to 2 Hp DC brushed motors. These full-wave rectified drives are a cost - effective solution for variable speed, process control applications requiring protection from wash-down, dirt and other corrosive elements. For added versatility, these drives have integrated isolation. | 13 |

| DRIVE | MODEL DESCRIPTION | PG. |
|---|---|---|
| MMXL05-D240AC-PCM | The MMXL Series are extremely compact, dual voltage PWM Open Chassis drives for 1/20th to 2 Hp DC brushed motors. The MMXL Series lowers audible noise and provides longer brush life for you motor. These drives maintain a 1.05 form factor at any speed in a 100:1 speed range. This means a decrease in motor temperature and motor maintenance. | 14 |
| XL3025A | The XL Series are dual voltage, PWM Open Chassis drives for 1/20th to 3 Hp DC brushed motors. These highly-efficient drives provide cool, quiet motor operation with extended brush life and low maintenance. For convenience, the drives have a cage-clamp terminal block for easy wiring. | 15 |
| XP02-115AC | The XP Series are PWM Open Chassis drives for 1/20th to 1 Hp DC brushed motors. Specifically designed for the OEM, the XP Series provides high performance at a low cost. The near unity form factor results in smooth, quiet, cool and low maintenance motor operation. Well suited for XL candidates that do not need all the features. | 16 |
| XP01-115AC-SL | The XP-SL Series are cost-effective, PWM Open Chassis drives for 1/100th to 1/4 Hp DC brushed motors. These drives can be used with shunt wound, series and permanent magnet motors. The PWM technology used in the XP-SL Series is capable of running motors at lower speeds without an increase in motor temperature. | 17 |
| DC5004Q-36/48 | Designed for battery operated electric vehicles using separately excited 36-48VDC DC motors. Rated for 200A continous armature current and peak of 500A for two minutes. Features include rollaway protection, battery under-voltage control, reverse alarm signal, regenerative braking fault detection, protection from overheating and outputs for an hour meter and speedometer | 18 |
| DC60-36/48 | DC input, DC output drives available in three sizes: Sixteen and 60A units for 12 or 24VDC motors and a 60A unit for 36 or 48VDC motors. The DC Series includes an inhibit, power LED, and six trimmer pot adjustments. Extruded chassis for better heat transfer to the heatsink, more bus capacitance to handle ripple currents and a convenient screw terminal block for power wiring. | 19 |
| XP32-12/24DC | The XP DC Series are cost-effective, PWM Open Chassis drives for 1/50th to 1 Hp DC brushed DC motors. Designed for applications running from a DC power supply or battery power input, the XP DC Series operate low voltage motors from 12 VDC to 60 VDC, up to 32 amps. PWM circuitry results in quick response and a constant 1.01 form factor through the 80:1 speed range. | 20 |
| LV Series | Minarik's LV Series of variable speed drives for your fractional horsepower, low voltage DC motor (12 and 24 VDC) using filtered pulse-width modulation (PWM). Compact, low cost drives are designed to provide 2% speed regulation throughout a 100:1 speed range. | 21 |
|  PCMXP02-115AC | The PCMXP Series are low-cost, high performance PWM Isolated Open Chassis drives for 1/20 to 1 Hp DC brushed motors. These drives accept any external analog process control from 0 to 10 VDC. Operates in three modes: manual, signal and signal with ratioing. PCMXP drives are available in 2, 5 and 10 amp versions. | 22 |
| C1XP01-115AC-A | C1XP Series are PWM NEMA 1 Enclosure drives for 1/100 to ¼ Hp DC brushed motors. PWM technology allows the drives to yield a constant 1.05 form factor over the 80:1 speed range resulting in smooth, quiet, cool and low maintenance motor operation. | 23 |
| C4XL3200A | The C4XL Series are dual voltage, high performance PWM NEMA 4X Enclosure drives for 1/20 to 2 Hp DC brushed motors. PWM technology allows the drives to yield a constant 1.05 form factor over the 100:1 speed range resulting in smooth, quiet, cool and low maintenance motor operation. Enclosure protects the drive from accidental contact, liquids, falling objects and corrosive agents. | 24 |
|  RG500UA | The RG Series consists of dual voltage, full-wave, four-quadrant operation in a PWM Regen Open Chassis drive for the 1/20th to 2 Hp DC brushed motors. Applications with overhauling loads, rapid deceleration, basic positioning and high duty cycles with reversing and braking will benefit from the RG Series. Also available with isolation option. | 25 |

# Drives Description Index

| DRIVE | MODEL DESCRIPTION | PG. |
|---|---|---|
| RG5500U | The RG5500U is a dual voltage, isolated four quadrant regenerative drive. This full featured drive has nine calibration posts, on board fusing and a terminal block. It can accept analog or current input reference signals and an analog tach for improved speed regulation. | 26 |
| RG60U | The RG60U is a compact, dual voltage, full-featured regen drive rated at 1hp (2hp with heatsink). Included are enable and inhibit terminals with an invert option, nine trimmer pots - including forward and reverse independent adjustments for acceleration and torque. The RG60U has two option cards available: (-T for torque control and -PCM adds isolation. The RG60U's robust design is ideal for high-duty cycle reversing and braking applications. | 27 |
| MMRG31U | The MMRG Series are extremely compact, full-wave, four-quadrant SCR Regen Open Chassis drives for 1/20th to 2 Hp DC brushed motors. These drives are excellent for Reversing and Braking applications with high duty cycles. Both 115 and 230 models available. | 28 |
| MMRGD03-D230AC | The MMRGD Series are extremely compact, dual voltage SCR Digital Regen Open Chassis drives for 1/20th to 2 Hp DC brushed motors. These drives are excellent for Reversing and Braking applications with high duty cycles. | 29 |
| RGT300U | The RGT Series features full-wave, four-quadrant operation in a PWM Regen Open Chassis drive for 1/20 to 2 Hp DC brushed motors. These drives are excellent for high speed regenerative braking and reversing. The "T" stands for "trimmed down" features for streamlined applications and high volume. Available in 115 and 230 VAC. | 30 |
| RG25U | The RG25U Series and RG51UA drives are half- wave, regenerative SCR drives. These drives offer the benefits of a low cost four-quadrant drive in a compact package and are ideal for low duty cycle applications. | 31 |
| NRG-4Q | The NRG-4Q Series features dual voltage, full-wave, four-quadrant operation in a PWM Regen Open Chassis drive for 1/20 to 1.5 Hp DC brushed motors. These drives are excellent for high speed regenerative braking and reversing and maintain a low 1.05 form factor. The NRG-4Q Series also lowers audible noise and provides longer brush life for your motor. | 32 |
| NRG-2Q | The NRG-2Q Series features dual voltage, full-wave, two-quadrant operation in a PWM Regen Open Chassis drive for 1/20th to 1.5 Hp DC brushed motors. These drives increase motor response while reducing your energy costs. The NRG-2Q Series also lowers audible noise and provides longer brush life for your motor. | 33 |
| RG500A | The RG Series consists of dual voltage, full-wave, four-quadrant operation in a PWM Regen NEMA 4X Enclosure with membrane panel for 1/20th to 2 Hp DC rushed motors. Applications with overhauling loads, rapid deceleration, basic positioning and high duty cycles with reversing and braking with benefit from the RG Series. The NEMA 4 Enclosure protects the drive from accidental contact, liquids, falling objects and corrosive agents. | 34 |
| RG501A | | 35 |
| C1RGD03-230AC | The C1RGD Series is our low cost solution for SCR Digital Regen NEMA1 enclosed drives for 1/20th to 1HP DC brushed motors. These drives are dual voltage and have three different braking modes: regenerative brake, regenerative deceleration and coast. The NEMA 1 enclosure protects the drive from accidental contact and falling objects. | 36 |

| DRIVE | MODEL DESCRIPTION | PG. |
|---|---|---|
| VFD-PCM Series | The VFD-PCM Series has three NEMA 4X enclosure choices rated to 4A or an open chassis unit rated to 5A. Features include isolated front end, minimum speed adjustment potentiomer, DC injection braking, automatic or manual restarts and a "doubling" jumper. | 50 - 52 |
| VFD04-230AC | The VFD Series has several compact units available in the 1/4 to 1 Hp range for 115 or 230VAC input. Some models can provide a 230VAC output with a 115VAC input. All models include six trimmer pot adjustments and three LEDs. The carrier frequency is an adjustable 4-16kHz and the output frequency is 30-120Hz adjustable. An optional plug-in isolation board is available that accepts 0-5VDC, 0-10VDC or 4-20mA reference signals. Use the VFD series for your variable frequency AC motor requirements. | 53 |
| MAC05-D240AC | The MAC Series AC drives control any ¾ or smaller, 115 or 230 VAC 3-phase AC induction motor. To help improve AC motor performance, the MAC Series includes torque boosting during acceleration, adjustable torque at low speeds, adjustable slip compensation, and adjustable min and max speeds. Solid-state reversing, adjustable acceleration and deceleration, I2T class current trip to protect the motor, control and machine. | 54 |
| ACM100 Series | The AC100 Series of variable frequency drives are programmable and easy to use. These drives are IP20 enclosed and feature nine isolated inputs and outputs. Forty-two programmable parameters, DC injection braking and more. For use with 3-phase AC induction motors up to 3 Hp. | 55 |
| AC200 Series | The AC200 Series are programmable variable frequency drives for 3-phase AC induction motors up to 20 Hp. They come in an IP20 enclosure and include 18 isolated inputs and outputs, forty-seven programmable parameters, DC injection braking and more. | 56 |
| AC300 & AC400 Series | The AC300 and AC400 Series of AC variable frequency drives are available for 3-phase AC induction motors up to 60 Hp. They are available in Nema 1, 4, 4X or Nema 12 enclosures. These drives feature 21 isolated I/O and fifty-five programmable parameters. The AC400 includes PID controller for closed loop control. | 59 |
| LVBL02-24AC/DC | The LVBL Series are Low Voltage Brushless Open Chassis drives designed to meet the demands of today's brushless motors. The compact chassis is easy to wire and calibrate with its screw-clamp connector and two trimmer pots for min and max speeds. Input voltage 24-36 (AC) and 24-48 (DC). | 68 |
| BOSS15AC-1Q | The BOSS 1Q Series are Brushless Single-Quadrant Open Chassis drives for brushless motor control application ½ to 2 Hp. These drives are compact, require little or no maintenance, and provide cool running, quiet motor operation with excellent speed range (80:1 open-loop). Standard drives output 4, 8, 15 amps continuos with peak currents reaching 200% of continuous rating for one second. | 69 |
| BOSS15-115AC-4Q | The BOSS-4Q Series are Brushless Four-Quadrant Open Chassis Drives for brushless motors 1/2 to 2 Hp. These drives can be run in four different modes: Voltage mode, velocity mode, tach mode, and current mode. A removable daughter card provides diagnostic outputs for run/stop indication, speed signal, average RMS current signal and phase current signal. Brushless systems require little or no maintenance and provides cool running, quiet motor operation with excellent speed range. | 70 |
| BOSS15-115AC-CM | The BOSS-CM Series was designed for use with front-end servo controllers. It is an isolated unit that will accept an analog or PWM reference signal. It accepts either an AC or DC input voltage and controls brushless DC motors. The BOSS-CM is a four-quadrant drive with 3kHz bandwidth resulting in a very responsive servo system. | 71 |
| MMBOSS05-24DC-1Q | The MMBOSS Series is a Low Voltage (12-40VDC) DC Input, DC Output, brushless drive. It includes features such as reversing, braking, a terminal block and 22kHz switching frequency all in our compact, standard footprint. | 72 |

# Product Technologies

## YOUR SOURCE FOR AC & DC MOTOR CONTROL

### DC Drives:

- Regenerative
- SCR
- PWM
- Brushless
- Digital
- NEMA Enclosure and Chassis Models

### AC Drives:

- Programmable
- NEMA Enclosure, IP20 and Chassis Models

### Motors:

- DC Geared
- DC Non-Geared
- DC Brushless
- DC Permanent Magnet
- AC 3-phase Geared
- AC 3-phase Non-Geared

### Gearheads:

- 17, 23, 34, 42 Frame Planetary Gearheads

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